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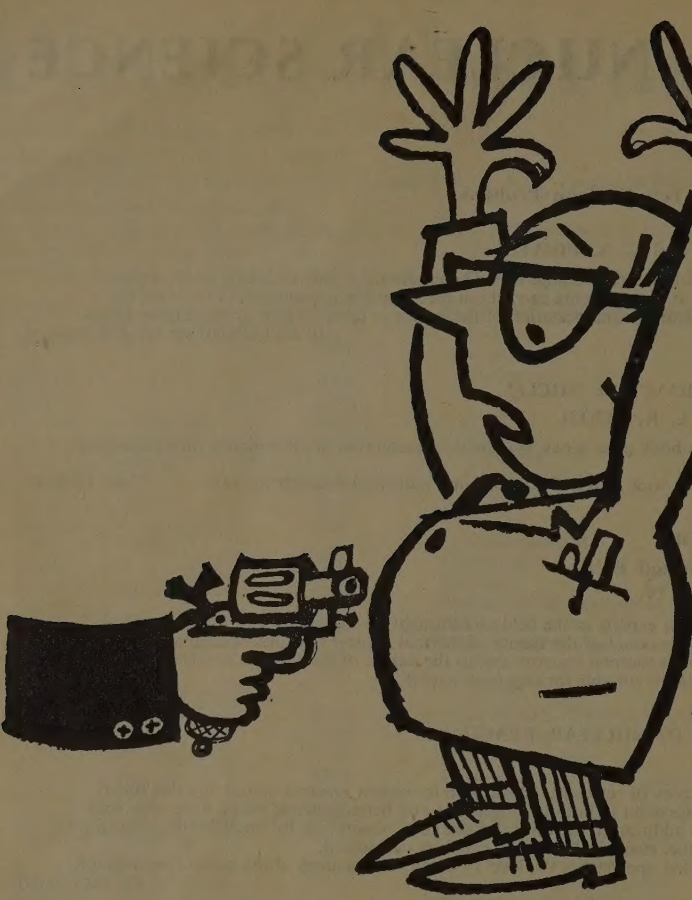

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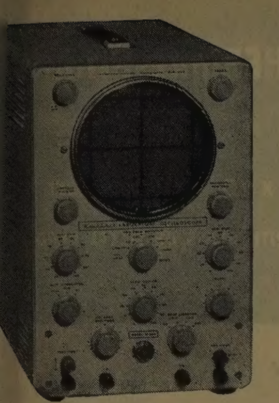

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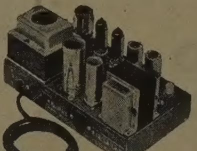

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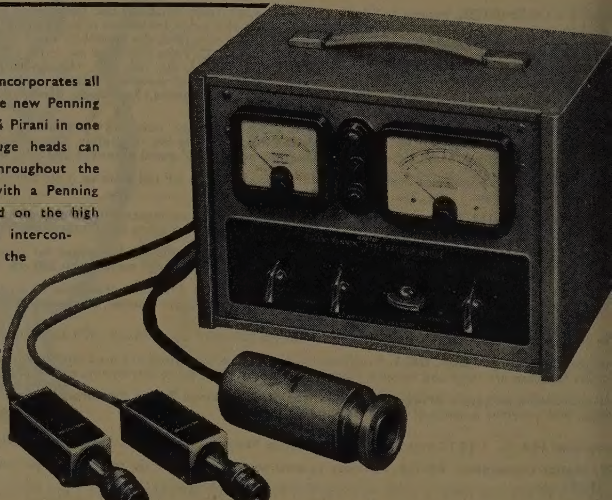

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MATHEMATICS

516

8568 CARTESIAN TENSORS. AN INTRODUCTION.

G.Temple.

don: Methuen and Company; New York: John Wiley and Sons
0) vii + 92 pp.

The original definition of a tensor as a set of variables which transformed cogradiently with the coordinate system with which are associated has been replaced by the Bourbaki definition tensor as a multilinear function of vectors. The purpose of book is to provide an introduction in terms of this concept. The icture of tensors is given in terms of eigenvectors. Isotropic sors are discussed in an elementary way and there is an account pinor theory. The final chapter is devoted to orthogonal vilinear coordinates. Numerous examples are interspaced ughout the book and there are sections on applications to the ry of elasticity, electromagnetism and fluid dynamics. The k is kept within the confines of three-dimensional space.

517

8569 REPRESENTATION OF A PHYSICAL PHENOMENON BY SUMS OF TRANSLATED FUNCTIONS.

rsac and J.C.Simon.

. Radioelect., Vol. 15, 217-27 (July, 1960). In French.

A theory of the exact representation of a bounded spectrum ction by a sum of translates with bounded spectra and a theory he approximate representation of a bounded spectrum function by im of bounded support translates, allows of a generalization of Shannon representation, of obtaining many polynomial inter- ation formulae, and of securing simple representations leading ery close approximations. Such methods are applied to the ory of linear filters, to the synthesis of radiation diagrams, and nterferometric measurements.

517

18570 SPEEDING UP MAYANTS' METHOD OF MAKING THE ROOTS OF SECULAR [CHARACTERISTIC] EQUATIONS RE PRECISE. B.L.Livshits.

l. Akad. Nauk SSSR, Vol. 132, No. 6, 1295-8 (June 21, 1960).
Russian.

The iterative procedure of Mayants (Trudy fizicheskogo ituta Akademii Nauk SSSR, Vol. 5, 1950) may be accelerated ny stage by using a power series, which must be absolutely vergent. G.A.Chisnall

517

18571 THE METHOD OF PERTURBATIONS FOR AN OPERATOR OF SIMPLE STRUCTURE. B.L.Livshits.

l. Akad. Nauk SSSR, Vol. 133, No. 4, 800-3 (Aug. 1, 1960).
Russian.

Perturbation theory is developed in such a way that it can be d to find the eigenvalues and eigenvectors of an operator of ple structure, even if the operator is non-Hermitian.

D.J.Thouless

517

18572 THE EFFECT OF BOUNDARY CONDITIONS AND MESH SIZE ON THE ACCURACY OF FINITE DIFFERENCE LUTIONS OF TWO-POINT BOUNDARY PROBLEMS.

orwein and A.R.Mitchell.

angew. Math. Phys., Vol. 10, No. 3, 221-32 (1959).

Consider an inhomogeneous boundary value problem for an inary linear differential equation of the second order with con- nt coefficients. There are known exceptional cases for which the damental interval is "critical" in the sense that there is no solution to the problem. Similarly, when the differential equation is approximated by a difference equation, the latter possesses critical intervals. It is shown that for an interval that is nearly critical the solution of the difference equation can differ considerably from the solution of the differential equation. Further, it is proved that as the mesh of the difference equation is reduced its critical intervals either tend to those of the differential equation or increase without limit. R.O.Davies

517

18573 SOLUTION OF THE POISSON EQUATION RELATED TO A BOUNDARY-VALUE PROBLEM FOR THE SPHERE.

E.E.Jones.

Z. angew. Math. Phys., Vol. 11, No. 4, 265-72 (July 25, 1960).

The author obtains solutions for the exterior--interior type of boundary problem, when the potential functions φ (exterior and interior) satisfy Poisson differential equations of form: $\nabla^2\varphi$ = function of position, and when the boundary is the surface of a sphere. There is a discussion of particular cases, possible fields of application for each case being described. N.L.Johnson

518

18574 OPERATIONS RESEARCH.

P.M.Morse.

Frontiers of numerical mathematics symposium, Wisconsin, 1959 (see Abstr. 12232 of 1960) Paper Five, p. 69-77.

Some typical problems are discussed, such as inventory control, allocation of effort, study of competitive situations. When a complicated situation is simulated on a large computer, the effects of changes in the basic conditions can be quickly found. The study of such effects may serve as a substitute for "experiments" on the actual system, or may lead to a simpler or more accurate solution of the problem. H.N.V.Temperley

518 : 681.142

18575 ELECTRONIC DEVICES FOR ANALOGUE MULTIPLICATION AND DIVISION OF EXPONENTIAL FUNCTIONS. G.Stainov, A.Derzhanski and M.Dimitrova.

C. R. Acad. Bulg. Sci., Vol. 11, No. 6, 465-8 (Nov.-Dec., 1958).
In Russian.

Circuits are described for analogue multiplication of two or more exponential functions using thermionic valves. Division is performed on similar circuits. The accuracy of operation is found to be better than 2%. A.Woroncow

518 : 531.25

AN ELECTRICAL ANALOGUE SOLUTION FOR THE STRESSES NEAR A CRACK OR HOLE IN A FLAT PLATE. See Abstr. 19030

518 : 681

18576 DIGITO-ANALOGUE COMPUTER FOR SOLVING LINEAR SIMULTANEOUS EQUATIONS AND RELATED PROBLEMS. E.V.Krishnamurthy.

J. sci. Instrum., Vol. 37, No. 11, 419-24 (Nov., 1960).

Describes Līlāvati model III, a digito-analogue computer for solving simultaneous and secular equations by a variety of iterative processes. Unlike the other computers in this field, multiplication is carried out by using Ohm's law and addition by null methods. The familiar Kelvin—Varley slide forms the basic circuit of the computer. This, in addition to simplifying the number of components involved in the computer, provides a method of feeding in and taking out the data as numbers, correct to three significant figures. An accuracy of between one and two parts in a thousand is readily obtainable.

518.5 : 537.54 : 681.142

ANALOG COMPUTER FOR CHARGED PARTICLE TRAJECTORIES. See Abstr. 19784

518 : 681.142

18577 INEXPENSIVE GRAPH PLOTTER FOR FIVE-TRACK PAPER TAPE. L.Molyneux and E.E.Schneider.
J. sci. Instrum., Vol. 37, No. 11, 425-31 (Nov., 1960).

The device will produce a graph from data in the form of five-track paper tape. The rate of plotting is 20 points per minute at an accuracy of up to one part in 1000. Apart from a standard ten-millivolt potentiometric recorder and tape reader, the device requires 21 transistors, 2 valves and 22 relays.

519

18578 REMARKS ON THE PAPER "REGENERATIVE STOCHASTIC PROCESSES". W.L.Smith.
Proc. Roy. Soc. A, Vol. 256, 496-501 (July 19, 1960).
The proof of a theorem in this paper (Abstr. 9354 of 1955) assumes more than it should and a new proof is given. For certain (unusual) kinds of process the definition which was given in the paper is inadequate to define the process for all values of the time parameter, and this weakness is removed. Furthermore, a "regularity" condition for a semi-Markov process to have step-function realizations (almost certainly) was given incorrectly; this error is now corrected, and certain other "regularity" conditions are discussed.

519

18579 SELECTED BIBLIOGRAPHY OF STATISTICAL LITERATURE, 1930 TO 1957. III. LIMIT THEOREMS.
L.S.Deming.
J. Res. Nat. Bur. Stand., Vol. 64B, No. 3, 175-92 (July-Sept., 1960).
For Pt I-II, see Abstr. 6546-7 of 1960.

519

18580 COMMENTS ON "ON THE STABILITY OF RANDOM SYSTEMS". T.K.Caughey.
J. Acoust. Soc. Amer., Vol. 32, No. 10, 1356 (Oct., 1960).
See Abstr. 8467 of 1960.

519

18581 REMARKS ON Dr. CAUGHEY'S COMMENTS ON MY PAPER ENTITLED "ON THE STABILITY OF RANDOM SYSTEMS, ETC". J.C.Samuels.
J. Acoust. Soc. Amer., Vol. 32, No. 10, 1356 (Oct., 1960).

ASTROPHYSICS

522

18582 THE NEW I.A.U. SYSTEM OF GALACTIC COORDINATES (1958 REVISION).
A.Blaauw, C.S.Gum, J.L.Pawsey and G.Westerhout.
Monthly Not. Roy. Astron. Soc., Vol. 121, No. 2, 123-31 (1960).

The definition of a new system of galactic coordinates was recently announced by Sub-Commission 33b on behalf of the I.A.U. The present paper is the first of a series of five, which together form the final report of the Sub-Commission. It summarizes the observational evidence, given in detail in the other papers, relevant to setting up the new system, it discusses various considerations which were taken into account, and it concludes with a definition of the new system.

522 : 523.16

A 21-CM DETERMINATION OF THE PRINCIPAL PLANE OF THE GALAXY. See Abstr. 18675

522 : 523.16

RADIO DATA RELEVANT TO THE CHOICE OF A GALACTIC COORDINATE SYSTEM. See Abstr. 18657

522 : 523.85

OPTICAL DETERMINATIONS OF THE GALACTIC POLE. See Abstr. 18827

522 : 523.16

THE POSITION OF THE GALACTIC CENTRE. See Abstr. 18658

522.3 : 531.

18583 PHOTOELECTRIC METHOD FOR RECORDING CIRC READINGS OF MERIDIAN INSTRUMENTS.
A.A.Efimov and Yu.M.Otryashenkov.
Astron. Zh., Vol. 37, No. 1, 146-50 (1960). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, 140-4 (July-Aug., 1960).

A photoelectric technique for recording circle readings has b developed, and an experimental working model has been built. Tests of the arrangement have shown that this method can be use for automatic recording of limb readings to a precision of 0.1 μ i linear units. Errors in the readings are largely independent of th quality of the calibration marks, which may be dark against a lig background, or vice-versa.

522.5 : 535

18584 THE FABRY—PEROT MONOCHROMATOR. J.E.Geake, J.Ring and N.J.Woolf.
Monthly Not. Roy. Astron. Soc., Vol. 119, No. 6, 616-28 (1959).

Many astronomical spectrographs are inefficient in the sens that light from the telescope image is both rejected at the entran slit and wasted by the low quantum efficiency of the photographic plate. There are many problems for which the second of these losses may be reduced by the use of a photoelectric detector. It shown that in such cases the addition of a Fabry—Perot monochr mator will allow the use of a much wider entrance slit for a give resolution. The theory of this Fabry—Perot monochromator is considered and leads to the conclusion that the interferometer is best used in an on-axis arrangement. Such a system has been developed and tested experimentally both in the laboratory and wi a 120 cm telescope. Comparisons have been made between a pri monochromator used to study short regions of the spectrum of st s and nebulae, both alone and with an interferometer in an on-axis d an off-axis arrangement. The results show that the on-axis arra e ment gave a gain of light of about thirteen, and was limited by the goodness of the surfaces of the optical flats used. The system de cribed can be attached to any existing monochromator.

522.5 : 538

18585 INFORMATIONAL CONSIDERATIONS IN THE DESIG OF ASTRONOMICAL SPECTROGRAPHS. E.H.Linfo
Monthly Not. Roy. Astron. Soc., Vol. 121, No. 1, 115-22 (1960).

The problem of designing spectrographs so as to maximize their information rate on random low-contrast spectral distributions is considered. It is shown how spectrographs can be discus d within the general framework of Fourier optics. The effects of optical aberrations, of photographic spread and granularity, and of variation of slit width are briefly considered and the implications of the band-limitedness of optical images in the problem of allowing for instrumental bandwidth are pointed out. An approximate expression for the information rate is obtained in the specia case of an aberration-free spectrograph.

522.5 : 535.2

18586 THE PHOTOELECTRIC PHOTOMETER OF THE TUR ASTRONOMICAL OBSERVATORY.
G.Cocito and A.Masani.
Mem. Soc. Astron. Ital., Vol. 31, No. 1, 135-45 (1960). In Italian.

The photoelectric photometer attached to the 30 cm Merz refractor of the Observatory of Turin is described. The spectral response curve for the 19-dynodes Lallemand multiplier phototube is plotted with the spectral transmission curve for the filters. A subsidiary apparatus for achieving the photon counting is also described.

522.5 : 535.

18587 INSTRUMENT PROFILE AND RESOLVING POWER O THE 9 METRE SPECTROGRAPH. R.Michard.
Ann. Astrophys., Vol. 22, No. 2, 185-7 (1959). In French.

The instrumental profile of the 9 m spectrograph has been found for usual working conditions by the spectrophotometry of iodine vapour absorption lines. The corresponding resolving powe in the sense Abbe is $\lambda/\Delta\lambda = 445\,000$ (5th order), or 90% of the theoretical power.

522

18588 ATTAINMENT AND POSSIBILITIES OF EMPLOYMEN OF A COMPENSATED PHOTOELECTRIC STELLAR SPECTROPHOTOMETER. P.Guérin.
Ann. Astrophys., Vol. 22, No. 6, 611-80 (1959). In French.

Description of an experimental stellar photoelectric low dis-
on spectrophotometer (mean resolving limit: 44 A) using two
mand 19-stage photomultipliers, one for the scanning of spectra,
ther for the compensation of the admitted flux. Spectral
val: 6000-3500 A. Tracings are made on sensitive paper by
oggendorf method, using a logometer. The instrument has
used for the determination of the relative gradients and Balmer
ntinuities for early type stars of magnitude less than 8. Pro-
for the construction of a new spectrophotometer of the same
allowing in particular the accurate determination of the equi-
t widths of isolated lines.

522.5 : 539.2 : 535.37

589 NEW CONSTANT-BRIGHTNESS PHOSPHORS FOR SPECTROPHOTOMETRY OF FAINT [CELESTIAL]
ECTS. ENERGY DISTRIBUTION IN THE SPECTRUM OF THESE
SPHORS. N.N.Pariiskii and L.M.Gindilis.
on. Zh., Vol. 36, No. 3, 539-43 (1959). In Russian. English
slation in: Soviet Astron.—AJ(New York), Vol. 3, No. 3,
8 (Dec., 1959).
Constant-brightness phosphors, with β-active activators and a
nuous spectrum in a broad band of wavelengths (developed at
uminescence Laboratory of the P.N.Lebedev Physical Institute,
e USSR Academy of Sciences) should be useful in the absolute
trophotometry of faint celestial objects. The present paper
rts a study of the energy distribution in the spectrum of such
phors, activated with Sr^{90} which has a half-life of 20 years.
visual brightness of the phosphors was 0.015 apostilb. The
gy distribution in absolute units was investigated in the wave-
h interval 4400 to 6400 A by comparison with the energy distrib-
in the spectrum of α Lyr and reference to the sun through the
ar magnitudes of α Lyr and the sun. The results were given
gs and quanta per cm^{2} per steradian per second for the interval
1 cm. The brightness was of the order of 600 quanta per cm^{2}
second for a solid angle of 1 square degree and an interval
1 A.

522.5

590 A TWO-CHANNEL POLARIMETER AND ITS APPLICATIONS IN ATMOSPHERIC OPTICS AND ASTRO-
SICS. V.G.Fesenkov.
on. Zh., Vol. 36, No. 6, 1094-110 (1959). In Russian. English
slation in: Soviet Astron.—AJ (New York), Vol. 3, No. 6,
-22 (May-June, 1960).
The description and theory are given of a polarimeter, capable
easuring quickly and precisely all four parameters of polariza-
The method is to measure simultaneously the sum and dif-
nce of the intensity of radiation of an object in two mutually
edicular planes. One form of the instrument uses 2 Se photo-
arranged to operate differentially. This has been used for
ematic observations of the clear-day sky. The model uses
photomultipliers and is specifically for polarimetric investi-
ns of the airglow and Zodiacal Light. A universal instrument,
h can be attached to any telescope, has been designed and
ed under laboratory conditions.

522.5 : 537.533

591 THE ACTUAL POSSIBILITIES OF ELECTRONIC PHOTOGRAPHY.
llemand, M.Duchesne, G.Wlerick, R.Augard and M.F.Dupre.
Astrophys., Vol. 23, No. 3, 320-30 (1960). In French.
"Galactic and extragalactic research" Conference (see Abstr.
2 of 1960). Results achieved by the electronic camera as an
nomical instrument indicate a gain in sensitivity of 1000 to
0 in comparison with ordinary photography, if the plate is
ced by counting the trails of the photoelectrons. Microphoto-
ic measurements give further gains of 50 to 100. Contrast and
ition of the images are also definitely improved.

522.5 : 537.533

3592 SOME RESEARCH INTO THE GRADUAL DEVELOPMENT OF ELECTRONIC PHOTOGRAPHY.
ehrenbach.
Astrophys., Vol. 23, No. 3, 335-43 (1960). In French.
"Galactic and extragalactic research" Conference (see Abstr.
32 of 1960). The author considers the possibilities of the sen-
ity and contrast of the electronic camera, especially when it
ssociated with various spectrographs. Its use is proposed for
study of type II stellar populations, interstellar calcium lines,
profiles, and the rotation and expansion of galaxies.

522.9

18593 THE CALCULATION OF THE COMBINED EFFECT OF DIFFERENTIAL REFRACTION AND ABERRATION.
S.Z.Omarov.
Astron. Zh., Vol. 36, No. 3, 535-8 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3, 520-3 (Dec., 1959).

Some recommendations are given on the practical application of the equations derived by the author for calculating the combined effect of differential refraction and aberration.

522.9

18594 DETERMINATION OF THE POSITION OF THE COLLIMATION LINE. G.P.Pil'nik.
Astron. Zh., Vol. 36, No. 5, 874-82 (1959). In Russian. English translation in: Soviet Astron.—AJ(New York), Vol. 3, No. 5, 849-56 (March-April, 1960).

It is usually assumed that during a night of observations the position of the collimation line in the body of the instrument does not change. It is shown in this paper that this assumption is incorrect. The law of variation of the position of this line as a function of the zenith distance is given for two transit instruments. An analysis of the errors in the determination of collimation and the clock correction leads to the conclusion that these errors are quite common.

523

18595 PHOTOELECTRIC PHOTOMETRY IN ASTRONOMICAL STUDIES. F.B.Wood.
Science, Vol. 132, 1123-7 (Oct. 21, 1960).

Review article.

523

18596 ON THE COMPUTATION OF NEARLY PARABOLIC TWO-BODY ORBITS. C.E.Herrick.
Astron. J., Vol. 65, No. 6, 386-8 (Aug., 1960).

A solution is given for the accurate computation of time in nearly parabolic two-body orbits which employs the true anomaly as the angular variable. It yields accuracy unattainable by any method found in the literature.

523

18597 AN ALGORITHM APPLICABLE TO NUMERICAL INTEGRATION OF ORBITS IN MULTIREVOLUTION STEPS. C.J.Cohen and E.C.Hubbard.
Astron. J., Vol. 65, No. 8, 454-6 (Oct., 1960).

In the numerical integration for orbits, it has been proposed that the secular variation of the orbit elements be computed in multirevolution steps. An algorithm is developed for a k-revolution step which is analogous to the algorithm for a step of integration by Adams' method. The analogue of the derivative generated at each integration step by Adams' method is the increment to the orbit elements for one revolution generated at each k-revolution step. The coefficients in Adams' integration formula are replaced by polynomials in 1/k. These polynomials are the same as those appearing as coefficients in Lubbock's summation formula and the constants in these polynomials are the Adams coefficients.

523

18598 ABSTRACTS OF PAPERS PRESENTED AT THE 106th MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY, AUGUST 22-25, 1960 AT THE UNIVERSIDAD NACIONAL DE MEXICO, MEXICO CITY.
Astron. J., Vol. 65, No. 9, 481-504 (Nov., 1960).

523.1

18599 A COVARIANT FORMULATION OF THE LAW OF CREATION OF MATTER. F.Hoyle.
Monthly Not. Roy. Astron. Soc., Vol. 120, No. 3, 256-62 (1960).

A covariant law is given for the creation field of matter. When the electromagnetic and nuclear fields, and the stress within matter, are omitted from the energy-momentum tensor, the Einstein equations possess an infinity of isotropic, homegeneous, stable steady-state solutions. The possibility exists that, if the neglected terms were reinstated, the solutions would possess a slow secular drift.

523.1

18600 THE HUND GRAVITATIONAL EQUATIONS AND THE EXPANDING UNIVERSE. Ll.G.Chambers.
Monthly Not. Roy. Astron. Soc., Vol. 120, No. 3, 263-70 (1960).

It is shown that the Hund gravitational equations can be applied to a spherically expanding universe. The experimentally determined constants are used to measure the age of the universe.

523.11

18601 **ON THE STEADY-STATE THEORY OF COSMOLOGY.** P.Roman.

Nuovo Cimento, Vol. 18, No. 1, 9-20 (Oct. 1, 1960).

It is shown that there is no contradiction between "energy conservation" and the continuous creation of matter in an expanding universe. By applying Noether's theorem to the substratum, a modified conservation law is obtained which accounts automatically for the creation of matter. The substratum is treated as a relativistic fluid and the solution of the equations of motion determines the characteristics of the substratum and gives a picturesque interpretation to the process of creation of matter. An equivalent model within the framework of general relativity is set up.

523.11

18602 **COSMIC FORCE-FREE FIELDS.** S.A.Kaplan.

Astron. Zh., Vol. 36, No. 5, 800-6 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 5, 778-83 (March-April, 1960).

Cosmic force-free fields with constant α are studied in the most simple configurations: (1) a stratified flat force-free field and (2) a cylindrical helical field. For comparing the theoretical analysis of magnetic fields with observational data it is most convenient to find the correlation between the intensity and polarization of synchrotron radiation. It is shown that for a favourable orientation of the force-free magnetic field (the axis of symmetry is parallel to the plane of the celestial sphere) the polarization of synchrotron radiation does not depend on its intensity and is 100% for field (1) and 30-40% for field (2). If there is a dispersion of orientation, the polarization decreases considerably and gives an inverse correlation with intensity — regions with higher intensity should have smaller polarization. The reduction of measurements of polarization of the Crab nebula, which were made by Oort and Walraven, have led to a correlation which is not consistent with theoretical calculations if a force-free field is assumed in this nebula. However the role of selective factors is as yet not clear. It is noted that in field (1) motion of a shock wave is possible, which increases H and α in the ratio ρ_2/ρ_1 (density discontinuity in a shock wave) and does not distort the force-free character of the field. It is shown that a force-free magnetic field with internal motions of gas is probably unstable. Apparently in cosmic conditions force-free magnetic fields can only exist in rare cases.

523.11 : 550.3 : 538.3

COSMICAL MAGNETIC FIELDS AND THE HYDROMAGNETIC THEORY OF THE DYNAMO EFFECT. See Abstr. 19890

523.11

18603 **THE FLOW OF INFORMATION IN COSMOLOGICAL MODELS.** A.W.K.Metzner and P.Morrison.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 6, 657-64 (1959).

The rate of reception of information in a particular channel is defined as usual by $C = W \log (1 + b/N)$, where W is the bandwidth in which the signal power is b and the noise power N. W and b are expressed as functions of the Doppler ratio Z of the particular cosmological source under observation and are model-dependent. The steady-state model is chosen to illustrate this in detail, including a set of curves of C(Z) which show, for instance, that $C(Z) \sim Z^{-5}$ for large Z. Results are given for other models and are discussed in relation to their visual horizons, if any.

523.11

18604 **NUMBER COUNT RELATIONS IN OBSERVATIONAL COSMOLOGY.** W.Davidson.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 6, 665-81 (1959).

Theoretical formulae relating the counts of sources of radiation to other observable quantities in cosmology are systematically presented in the form considered most relevant to present day problems. These relations are particularly directed to the practical detection of evolutionary effects in the galaxies, employing quantities directly measured by astronomers and taking account of the possible variation of these quantities with epoch. The analysis is based on the Robertson—Walker space-time metric for a "smoothed out" universe, which still seems likely to be the most fruitful method of approach at the present time. The relations are designed to apply to the number counts of sources emitting in either the optical range of the spectrum or in the radio range, and these are determined in terms of both red shift and apparent magnitude. An alternative number count formula is derived which may possibly be more applicable in an evolutionar universe should radio sources arise by the collision of galaxies. Each relation is discussed in some detail with regard to the valu of its application to the actual universe. It is shown how the number counts may be employed to measure any secular rate of change that may exist in the strength of source emission, and how they may be utilized in conjunction with the red shift - apparent magn tude data to provide an independent measure of the extent of sele tion effect in the latter data. It is shown, also, how the number counts may independently provide the values of the Hubble parameter and the acceleration parameter of the expanding universe. The paper concludes with a systematic comparison between the observable number count characteristics of an evolutionary univ se and those of the steady-state model indicating several means of distinguishing between these two types of universe.

52

18605 **ANGULAR MEASUREMENTS IN OBSERVATIONAL COSMOLOGY.** W.Davidson.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 3, 271-85 (1960).

Theoretical formulae are derived which, by expansion in ser relate the observed angular diameters and angular separations o galaxies, radio sources, and clusters in an expanding universe to either the measured red shift or registered apparent magnitude o representative sources in the region of survey. It is shown that i principle the cosmological problem may be solved by fitting the observed data to these relations. In particular an evolutionary universe may be distinguished from a steady-state universe, and t Hubble parameter and acceleration parameter for either univers may be determined. Allowances are made for possible evolution trends in the sources, and it is shown how a progressive variatio in intrinsic size may be detected. Some exact relations between observables are provided for the steady-state model.

523

18606 **INTERPRETATION OF COSMOLOGY.** W.Davidson; W.H.McCrea.

Nature (London), Vol. 187, 583 (Aug. 13, 1960).

Davidson considers that evolutionary theories (by virtue of the cosmological principle) and, a fortiori, the steady state theor to some extent counter by their very natures McCrea's conclusio (Abstr. 16522 of 1960) regarding the inherent uncertainty in predictions of cosmological theories. In a brief reply, McCrea refer to some specific points and reaffirms his original thesis.

G.A.Chisn

523

18607 **ON THE POSSIBLE CONSEQUENCES OF A VARIABILITY OF THE ELEMENTARY CHARGE.** F.Hoyle.

Proc. Roy. Soc. A, Vol. 257, 431-44 (Sept. 27, 1960).

The cosmological effects of a slight difference of charge betw the proton and electron are considered. It is shown that in order obtain a steady-state solution of the cosmological equations the terms by which Maxwell's equations are modified must be of an opposite sign to that considered recently by Lyttleton and Bondi (1959). The change of sign has the effect of altering the Coulomb law of force between charges at large distances apart, in such a w that unlike charges repel while like charges attract. In the stead state solution the mean spatial density of matter is such that the electrostatic potential is of an opposite sign to that which would b given by Coulomb's law. In this situation the charges are in fact attractive, not repulsive as considered by Lyttleton and Bondi. T effect of creation of matter in pairs is considered. It appears tha the change of Coulomb's law might be used to separate matter an anti-matter. The process of separation produces an electric curr leading to the existence of an intergalactic magnetic field.

523.11 : 530

GRAVITATION AND THE PRINCIPLE OF STATIONARY ACTION. See Abstr. 18909

523.11 : 535

SCATTERING OF LIGHT IN A MEDIUM WITH A MOVING BOUNDARY. See Abstr. 19448

523.14

608

THE THEORY OF STRÖMGREN'S ZONES.

R.E.Gershberg and V.I.Pronik.

ron. Zh., Vol. 36, No. 5, 902-4 (1959). In Russian. English
slation in: Soviet Astron.—AJ (New York), Vol. 3, No. 5,
-8 (March-April, 1960).

Gives the radius scale of Strömgren's interstellar matter zones
ulated in accordance with theoretical models of early-type stars.
new scale is in good agreement with observed dimensions of
zones.

523.14

.8609

COSMIC EXAMPLES OF HEAT CONDUCTION IN VERY RARE ROTATING OR EXPANDING GASES.

napman.

. Geophys., Vol. 15, No. 4, 434-44 (1959).

As Maxwell first showed, in a very rare gas tangential stresses
produced by non-uniformity of temperature as well as of motion.
ilarly the heat flow in a very rare moving gas is not fully given
he usual formula. The additional terms in the heat flow are
ived for two types of motion, namely rotation and radial expan-
. Numerical illustrations are given relative to fully ionized
rplanetary atomic hydrogen, and to neutral atomic hydrogen in
earth's atmosphere and in interstellar space. It is shown that
uch extremely rare gases the additional terms, in some cases
nterest to cosmic physics, may have some importance relative
he usual term; but they are unlikely to affect the radial distribu-
of temperature.

523.14

18610

METHODS FOR THE OBSERVATION AND STUDY OF INTERSTELLAR HYDROGEN IN EMISSION.

G.Courtès.

. Astrophys., Vol. 23, No. 2, 115-217 (1960). In French.

Comparison between different detection and measuring techniques
nonochromatic interstellar emission strongly favours the use
he Fabry—Perot interference etalon. Observations shows that it
easier to obtain the interference rings than the direct photograph
nebula because of the high contrast of the rings on the sky
kground. A new instrument, the "focal reducer" increases the
l ratio of the big telescopes up to values reached only by small
neter Schmidt telescopes. This instrument has been designed
the best use of interference filters and the Fabry—Perot etalon
gives a definition close to the resolving power of the telescope
he average seeing conditions. A first determination of the
nsity ratio of [N II]/Hα, radial velocities and internal motions of
most important H II regions has been obtained with this instru-
nt. Hα emission is generally the strongest line in the 6560 A
ion with few exceptions. H II regions are found to participate in
general motion of interstellar matter. Some statistics about the
rnal motions are not in disagreement with a possible velocity
sipation law for interstellar hydrogen. The work concludes with
extension of the interference techniques to the small apparent
neter nebulae and nearest galaxies.

523.14

.8611

INTERSTELLAR MATTER IN ELLIPTICAL GALAXIES. II.

D.E.Osterbrock.

rophys. J., Vol. 132, No. 2, 325-40 (Sept., 1960).

For earlier work see Minkowski and Osterbrock, Astrophys. J.,
. 129, No. 3, 583 (May, 1959). Observations are presented of the
ission line resulting from ionized interstellar gas in elliptical
axies, together with a preliminary account of their interpretation.
strongest line (with respect to the continuous spectrum) is the
I] λ 3727 line, which occurs in different strengths in different
axies, down to vanishingly weak intensity. The profile of this
in NGC 4486, the radio source Virgo A, is broad and double.
IGC 4278, an otherwise typical elliptical galaxy with strong inter-
lar emission line, estimates of the mass, rotational velocity,
turbulent velocity of the ionized gas are given, as well as relat-
abundances of the observable ions. The mechanism by which the
rgy that is radiated in the emission lines is replaced is not
wn, but it may be either from ultraviolet stellar radiation or
m the conversion of stellar kinetic energy ultimately into heat.
s probable that all elliptical galaxies contain interstellar gas and
the observed relative strength or absence of emission lines is
gely an effect of ionization. The similarities and differences
ween the gas cloud in the nucleus of the elliptical galaxy NGC 4278
the gas clouds in the nuclei of our Galaxy, of M31, and of M81
briefly discussed.

523.14

18612

THE WAVELENGTH DEPENDENCE OF POLARIZATION. I. INSTRUMENTAL POLARIZATION.

T.Gehrels.

Astron. J., Vol. 65, No. 8, 466-9 (Oct., 1960).

The main purpose of this series of papers is to compare interplanetary and interstellar particles, with measures of polarization and colour over a wide range of wavelengths. This paper describes corrections for spurious polarization introduced by aluminized mirrors. Measures on nonpolarized stars are reported for the McDonald 82 in. and 36 in. and for the Goethe Link 36 in. reflectors. For different telescopes the amount of instrumental polarization differs greatly. The polarization increases toward the ultraviolet. The instrumental effects may cause photometric as well as polarimetric errors, and a method to avoid them (Thiessen and Broglia, 1959) is referred to. Measures on depolarization effects are reported and small corrections are derived for incomplete action of the depolarizer disks and of the Wollaston prism. Depolarization by the mirrors of the 82 in. telescope is found to be negligible.

523.14

18613

THE WAVELENGTH DEPENDENCE OF POLARIZATION. II. INTERSTELLAR POLARIZATION.

T.Gehrels.

Astron. J., Vol. 65, No. 8, 470-3 (Oct., 1960).

The probable error of the polarization measures is ±0.07 or ±0.0015 mag., found from observations made under various weather conditions. The interstellar polarization has a maximum at 6500 A, decreasing sharply toward longer and gradually toward shorter wavelengths. The wavelength dependence is qualitatively interpreted with computations (van de Hulst, 1957) of the extinction by aligned cylinders. Particle sizes of 0.05-0.49 μ are derived for various refractive indices; the agreement of observations and calculations is equally good for metallic and dielectric particles.

523.14

18614

THE DETERMINATION OF THE MEAN DIMENSIONS OF MAGNETIZED CLOUDS OF INTERSTELLAR GAS BY RADIOASTRONOMICAL METHODS.

G.G.Getmantsev.

Astron. Zh., Vol. 36, No. 3, 422-6 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3, 415-18 (Dec., 1959).

The mean dimensions of magnetized clouds of interstellar ionized gas may be found from measurements of the polarization of non-thermal radio radiation and from measurements of the intensity fluctuations of radio radiation, when the directional pattern of the radio telescope is swept across the sky. On the basis of published data, it is shown that $l \gtrsim 75$ pc.

523.16

18615

RADIO ASTRONOMY AND THE SOLAR SYSTEM (INTRODUCTORY LECTURE TO PART 1 - MOON AND PLANETS).

F.G.Smith.

Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 3-7.

A survey is given of the emission, both thermal and non-thermal from the moon and the planets, Venus, Mars, Jupiter and Saturn. Radar echoes from the moon have now been observed over a frequency range of 30 to 3000 Mc/s; the short length of the returned pulse is attributed to a lunar surface with areas included at less than 7° to the normal. It is suggested that the power reflection coefficient of the moon may be derived from measurements of reflected solar outbursts. Various methods of determining the density of interplanetary electrons are considered. R.D.Davies

523.16

18616

THE RAPID FADING OF MOON ECHOES AT 100 Mc/s.

J.V.Evans, S.Evans and J.H.Thomson.

Radio Astronomy Symposium, Paris, 1958 (See Abstr. 10477 of 1960) p. 8-12.

Radar echoes from the moon have been obtained with the 250 foot radio telescope at Jodrell Bank at 100 Mc/s giving a mean signal to noise ratio of 21.3 ± 2 dB. The total rate of libration falls rapidly either side of transit whereas the pulse to pulse correlation is a maximum at transit. The power spectrum of the echoes is derived and it is concluded that the scattering centres lie within a third of the radius of the centre of the disk. R.D.Davies

523.16

18617 RADAR OBSERVATIONS OF THE MOON AT 10-cm WAVELENGTH. J.S.Hey and V.A.Hughes.
Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 13-18.

Radio echoes were obtained from the moon at 10 cm wavelength using a pulse length of 5 μ sec. The derived distance to the moon differs from that given in the Improved Lunar Ephemeris by 1.53 km with a r.m.s. deviation of 1.25 km. The scintillation rate of the echo is greater behind the leading edge; the mean gradient of the lunar surface is about 1 in 20. R.D.Davies

523.16

18618 A LUNAR STUDY AT 10-cm WAVELENGTH. B.S.Yaplee, N.G.Roman, K.J.Craig and T.F.Scanlan.
Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 19-28.

Using a frequency of 2860 Mc/s and a pulse length of 2 μ sec the authors obtained a value for the distance to the moon each day over a period of a month. The residuals from the Ephemeris values showed a systematic trend which was interpreted as due to a possible error in the earth's equatorial radius, the moon's horizontal parallax or the moon's radius. Studies were also made of the mean surface of the moon. R.D.Davies

523.16

18619 RADAR REFLECTION CHARACTERISTICS OF THE MOON. T.B.A.Senior and K.M.Siegel.
Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 29-46.

Echoes from the moon are considered to arise principally from reflections from a smooth surface plus reflections from other specular areas so oriented as to direct a signal back to the earth. The mean permittivity and conductivity of the lunar surface are calculated. Also given is the design of a communication system employing reflection from the moon. R.D.Davies

523.16

18620 RADIO OBSERVATIONS OF THE LUNAR ATMOSPHERE. B.Elsmore.
Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 47-9.

Observations at 3.7 m wavelength were made of the occultation of the Crab nebula by the moon. The refraction of the Crab nebula in the sunlit ionized atmosphere of the moon was measured to be 13″.4 ± 8″.7. This result is scarcely significant but gives an upper limit to the electron density at moon's surface of 10^3 cm^{-3}. The corresponding density of lunar atmosphere assuming 0.1% ionization is about 2×10^{-13} of the earth's atmosphere at s.t.p. R.D.Davies

523.16

18621 OBSERVATIONS OF VENUS AT 8.6-mm WAVELENGTH. J.E.Gibson and R.J.McEwan.
Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 50-2.

A 10 foot aperture paraboloid with a beam width of 0°.2 at 8.6 mm was used to measure the aerial temperature of Venus. The brightness temperature of Venus was deduced to be 410° K ± 40%. R.D.Davies

523.16

18622 OBSERVATIONS OF PLANETARY NONTHERMAL RADIATION. H.J.Smith and J.N.Douglas.
Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 53-5.

Observations of Jupiter and Saturn were made in the frequency range 18-23 Mc/s using single aerials and interferometers. The burst occurrence probability for Jupiter at 18, 21 and 23 Mc/s was in the ratio 1 : 0.8 : 0.1. Some events were thought to be associated with Saturn but the evidence is inconclusive. R.D.Davies

523.16

18623 RADIO OBSERVATIONS OF THE COMET AREND-ROLAND. G.R.Whitfield and J.Högbom.
Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 56-7.

Observations were made at 3.7 and 7.9 metres wavelength in an attempt to detect radiation from the head and the tail of the comet and to set a limit to the scattering of emission from radio sources see through the cometary tail. No emission from the comet was detected and limits are given to its flux as derived at different in ferometer spacings. No scattering was observed and the upper limit of electron density in the cometary tail is estimated as 10^4 cm^{-3}. R.D.Davies

523.16

18624 THE IONOSPHERES OF PLANETS. F.Link.
Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 58-60

The observed characteristics of non-thermal emission from planets are considered in relation to the propagation conditions i their ionospheres. R.D.Davies

[illegible]

18625 PRELIMINARY OBSERVATIONS AT 10 CM WAVELENGTH USING THE N.R.L. 84 FOOT RADIO TELESCOPE. E.F.McClain and R.M.Sloanaker.
Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 61-8.

The efficiency of the reflector at 10.3 cm wavelength is 40% and the beamwidth is 18′.5 × 17′.5. The measured black body temperature of Jupiter varied from 395° to 860° K. This variation was greater than the errors of measurement, and was considered to b real. R.D.Davies

523.16

18626 OBSERVATIONS OF DISCRETE SOURCES AT 3 cm WAVELENGTH USING A MASER. L.E.Alsop, J.A.Giordmaine, C.H.Mayer and C.H.Townes.
Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 69-74.

The maser was of the 3 level type using ruby. The maser it contributed only several degrees, whereas 80° K was contributed losses in transmission lines and aerial spillover. Jupiter gave a aerial temperature 0.51° K which corresponded to a black body temperature of 165° K. The temperature of Venus was 575° K. R.D.Davies

523.16

18627 CONCLUDING LECTURE [PART I—MOON AND PLANETS]. A.C.B.Lovell.
Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 75-8.

A summary is given of the new results presented in this section which deals with radio echoes from, and radio emission from the moon and planets. Some unresolved problems are mentioned. R.D.Davies

523.16

18628 THE SOURCES OF RADIO EMISSION ON THE SUN. [INTRODUCTORY LECTURE TO PART II—THE SUN] J.F.Denisse.
Radio Astronomy Symposium, Paris, 1958, (see Abstr. 10477 of 1960) p. 81-8. In French.

The radiation from the sun consists of a quiet sun component a slowly varying component and various types of quickly changing o burst like components. Type I bursts comprise the noise storms. Type II bursts are the outbursts associated with flares. Type III bursts are isolated and have large frequency drifts. Type IV burs are a continium following outbursts. R.D.Davies

523.

18629 THE STRUCTURE OF THE CHROMOSPHERE AND T LOW CORONA. C.de Jager.
Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 89-97.

A model for the temperature distribution in the chromosphere and corona is adopted. This is explained in terms of the energy transfer through the solar atmosphere. The temperature variatio throughout the transition region is investigated. Possible emissio from the excited line of neutral hydrogen at 3.03 cm is predicted; observations were inconclusive. R.D.Davi

523.

18630 A MODEL OF THE CHROMOSPHERE FROM RADIO A OPTICAL DATA. R.G.Athay.
Radio Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) p. 98-104.

Radio and optical data have been used to construct temperatur lensity models of the chromosphere. Hot and cold spicules are oounded in different proportions at different heights.

R.D.Davies

523.16

3631 A MODEL OF THE INNER CORONA BASED ON RADIO DATA.

B.N.Panovkin.

o Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of) p. 105-6.

Radio observations of the brightness distribution across the t wavelengths in the range 21-145 cm can be explained in terms of nperature rising from the chromospheric to the coronal levels. maximum temperature is 3×10^{6} °K and occurs at 1.1 to 1.3 of ptical radius.

R.D.Davies

523.16

8632 THE QUIET SUN AT 88 cm WAVELENGTHS.

J.Firor.

o Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) 07.

The one-dimensional brightness distribution across the Sun was sured at 88 cm wavelength. The lower envelope of such scans n in 1957 can be explained in terms of a uniform disc 44 min of in diameter.

R.D.Davies

523.16

18633 THE ORIGIN OF THE SLOWLY VARYING COMPONENT.

W.N.Christiansen and D.S.Mathewson.

o Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of) p. 108-17.

The radio sources which make up the slowly varying component bove plages faculaires and regions of higher magnetic field nsity. Their average height is 40 000 km and average diameter 000 km. The mean brightness temperature of the sources is $\times 10^{6}$ °K. It is suggested that the sources are regions of high nal density; such regions are found in optical studies.

R.D.Davies

523.16

18634 A COMPARISON BETWEEN RADIOHELIOGRAMS AND OPTICAL OBSERVATIONS OF THE SOLAR CORONA.

aldmeier.

o Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) 18-22.

Coronograms of the green coronal line are compared with the oheliograms obtained by Christiansen and Mathewson at 21 cm elength. There is good agreement in spite of the fact that a given nal region can only be observed at the solar limb.

R.D.Davies

523.16

8635 PRELIMINARY RESULTS OBTAINED WITH AN 8 ELEMENT INTERFEROMETER AT 3 cm WAVELENGTH.

utmann and J.L.Steinberg.

io Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of)), p. 123-4. In French.

The interferometer has a resolution of 8 min of arc and it was l to observe the passage of radio centres across the disc. The tres are at a minimum height of 20 000 km and their emissivity es as the cosine as they move across the disc. R.D.Davies

523.16

18636 ON THE REGIONS OVER SUNSPOTS AS STUDIED BY POLARIZATION OBSERVATIONS AT CENTIMETER VELENGTHS.

elfreich, D.Korol'kov, N.Rishkov and N.Soboleva.

io Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) 25-8.

Eclipse observations were obtained during April 1958 at elengths of 5.1, 3.3 and 2.0 cm. Circular polarization of osite senses was obtained from radio regions lying above sun- t groups of north and south polarity. A magnetic field of 360 G a kinetic temperature of $7 \pm 3 \times 10^{6}$ °K were found for the ions observed.

R.D.Davies

523.16

18637 RADIO PICTURE OF THE SUN AT 3.2 cm WAVELENGTH.

V.V.Vitkevich, A.D.Kuz'min, A.E.Salomonovich and .Udal'tsov.

io Astronomy Symposium, Paris, 1958 (see Abstr. 10477 of 1960) 29-35.

A resolution of six min of arc was used to obtain the two-dimensional distribution of radio emission across the sun at 3.2 cm wavelength. Radio sources at a height of less than 0.1 solar radii move across the disc with the solar rotation. Most sources are associated with the larger sunspot groups. No radio emission was observed from prominences.

R.D.Davies

523.16

18638 IONOSPHERIC MODIFICATION OF THE RADIO EMISSION FROM JUPITER.

A.G.Smith, T.D.Carr, H.Bollhagen, N.Chatterton and F.Six.

Nature (London), Vol. 187, 568-70 (Aug. 13, 1960).

Simultaneous observations of the pulsed radiation from Jupiter made in Florida and Chile over a baseline of 7040 km show fair correlation over limited periods but poor or no correlation the remainder of the time. It is concluded that whereas pulsed radiation of duration about 1 sec originates on Jupiter, these pulses are frequently distorted by rapid scintillation of terrestrial origin accounting for the signals tending to appear as short trains of pulses. The terrestrial ionospheric does not appear to exert any gross influence on the polarization of Jupiter radiation since similar polarizations are observed simultaneously in magnetically opposite hemispheres.

C.Hazard

523.16

18639 RADIO EMISSION FROM JUPITER AT 408 Mc/s.

R.J.Long and B.Elsmore.

Observatory, Vol. 80, 112-14 (June, 1960).

Published measurements indicate the flux density of Jupiter to remain approximately constant between 400 and 3000 Mc/s. Interferometer measurements at 408 Mc/s give a much lower value than the published flux density if it assumed that the radio source has a diameter approximately equal to the optical diameter. If the previous observations near 400 Mc/s are not in error then the emission may vary with time or the planet may have a radio diameter at least five times the optical diameter. C.Hazard

523.16

18640 THE COLOURING MATTER AND RADIO EMISSIONS OF JUPITER.

M.H.Briggs.

Observatory, Vol. 80, 159-61 (Aug., 1960).

If the Great Red Spot on Jupiter is due to the presence of organic compounds produced by synthesis in Jupiter's atmosphere, then it is pointed out that the most probable source of energy for the synthesis is electric discharges. If it is assumed that these compounds are unsaturated compounds which gradually become saturated and lose their colour in the presence of the free hydrogen in Jupiter's atmosphere, then it is only necessary to postulate that the discharges are infrequent to explain the fading of the Red Spot. The recent detection of radio emission from Jupiter probably arising in electrical discharges offers a possible test of this hypothesis, as a positive correlation should exist between the intensity of the Red Spot and the radio emissions. C.Hazard

523.16

18641 THE SPECTRUM OF PEAKS IN SOLAR RADIO EMISSION.

V.V.Vitkevich, M.V.Gorelova and T.A.Lozinskaya.

Astron.Zh., Vol. 36, No. 4, 641-2 (1959). In Russian. English translation in: Soviet Astron.—AJ(New York), Vol. 3, No. 4, 626-7 (Jan.-Feb., 1960).

Two types of short-duration burst (pips or peaks) are described: narrow-band peaks with a bandwidth ranging up to 5 Mc/s, and wide-band peaks with a bandwidth of the order of 12-15 Mc/s.

523.16

18642 THE VISIBILITY OF THE 10-cm RADIO-EMISSIVE REGION AND ITS APPLICATION IN FINDING THE 10-cm QUIET SUN.

A.E.Covington and G.A.Harvey.

Astrophys. J., Vol. 132, No. 2, 435-51 (Sept., 1960).

The 10-cm radio emission for 26 individual regions of sunspot activity was measured at the National Research Council, Ottawa, Canada, with an 8-minute-of-arc fan-shaped antenna beam during a portion of 1952 when relatively few sunspots were present. On the average, the radio-emissive region appears on the eastern limb from 1 to 2 days before the visible sunspots and remains from 1 to 2 days longer on the western limb; the radio emission attains its maximum value 2 days before the region reaches the central meridian, and the sunspot area 4 days before the region reaches the central meridian. For individual regions of radio emission, a scatter diagram of radio flux versus sunspot area shows that there is a component of emission which is independent of area. This has led to a new expression in which the total daily flux from the solar disk is expressed empirically as the sum of three components: the first is the solar background, the second is related to the number of sunspot groups upon the disk, and the third is related to the area of the sunspots present. Values for the quiet sun for the years 1948-1956 have been derived.

523.16

18643 SPECTRUM OF 1957 NOVEMBER 4 SOLAR OUTBURST.

A.Boischot, F.T.Haddock and A.Maxwell.

Ann. Astrophys., Vol. 23, No. 3, 478-9 (1960).

The dynamic spectra of the abnormal radioemission received from the sun on Nov. 4, 1957 are presented. The identity between records taken at two remote stations is evidence for an origin of the intensity fluctuations very close to the sun. Some of their characteristics may give a clue to the explanation of the phenomenon.

523.16

18644 SOLAR RADIO EMISSION AT 9500 Mc/s. II. OBSERVATION OF THE SOLAR RADIO EMISSION.

K.Akabane.

Ann. Tokyo Astron. Obs. Univ. Tokyo, Vol. 6, No. 2, 65-100 (1958).

Observational results from June 1957 to May 1958 are summarized in this paper. The S-components at this frequency were ~ 10% circularly polarized,the sense of which changed near the C.M.P. of the enhanced region for a typically bipolar sunspot. In a few cases a small amount of linear polarization was detected. About 600 outstanding occurrences were observed in this period whose intensities were greater than 20 units (1 unit being 10^{-22} mks). The frequency distributions of outstanding occurrences for the intensity and for the percentage polarization were also established. Linear polarization was observed in many outbursts (greater than 100 units), and it is concluded that the source of outburst must have some linearly polarized component after consideration of the Faraday effect in the ionized medium. Two models for the enhanced region were made from the solar eclipse observations at 9500 Mc/s and at 3000 Mc/s, and a magnetic field which is inclined by about 30° to the east and west sides from the normal of the layer of enhanced region is proposed for a typically bipolar enhanced region. For a so called quiet sun at these frequencies, the bright region near the equator of the sun is detected by eclipse observations. It is also considered that the S-component and the outbursts will have excess radiation of the extraordinary wave for the magnetic field in their origins. A simple experiment on the generation of the extraordinary wave was made with a discharge tube put in a magnetic field. For Pt I, see Abstr. 16524 of 1960.

523.16

18645 STUDY OF THE RELATIVE POSITIONS OF SOURCES OF SOLAR RADIO STORMS AND OF ASSOCIATED CENTRES OF OPTICAL ACTIVITY.

E.J.Blum and A.M.Malinge.

C.R. Acad. Sci. (Paris), Vol. 250, No. 19, 3119-21 (May 9, 1960). In French.

The sources of radio storms observed at 169 Mc/s can mostly be associated with optical sunspots. From a comparison of the radio and optical positions the height of the storm regions was calculated to be 0.7 solar radii. There seems also to be a systematic displacement between the apparent position of storms and their real position in the solar corona. It is suggested that the most intense storms show directivity in latitude. R.D.Davies

523.16 : 523.74

A STUDY OF A SOLAR ACTIVE REGION USING COMBINED OPTICAL AND RADIO TECHNIQUES. See Abstr. 18732

523.16

18646 SHORT-TERM DIFFERENCES IN THE BEHAVIOUR OF TWO DAILY INDICES OF SOLAR ACTIVITY DURING THE I.G.Y.

G.H.Bazzard.

J. atmos. terrest. Phys., Vol. 18, No. 4, 290-6 (Aug., 1960).

The variations in the daily values of the flux of solar radio noise at λ 10.7 cm (Φ) and the E-layer character figure (J_E) have been studied for the period of the I.G.Y. It is found that Φ lags behind J_E by about 14 hr. The ratio J_E/Φ fluctuates above and below its normal value and the reasons for these changes have been examined. Troughs in J_E/Φ are attributed partly to increases in geomagnetic activity which cause a decrease in J_E, and partly to the presence of active regions on the sun's disk which tends to emit relatively more radio noise than the quiet sun. Peaks in J_E/Φ are associated with the absence of these active areas.

523.16

18647 ECLIPSE OBSERVATIONS OF MICROWAVE RADIO SOURCES ON THE SOLAR DISK ON 19 APRIL, 1958.

H.Tanaka and T.Kakinuma.

Rep. Ionosphere Space Res. Japan, Vol. 12, No. 3, 273-84 (Sept., 1958).

The partial and annular eclipse on 19 April 1958 was observ at Toyokawa and Hachijojima at four frequencies: 9400, 3750, 20 and 1000 Mc/s. Brightness distribution over the solar disk at the frequencies is derived with the aid of interferometric observatio at 4000 Mc/s in full course of the eclipse. The maximum brightness was, from 9400 to 1000 Mc/s, of the order of 10^5, 10^6, 2×10 and 3×10^6 °K, respectively. The source of polarization was strictly confined to a small area over the sunspot, about 1' in diameter. Thus, two sources of polarization of different sense exist over each pole of a bipolar sunspot. The polarization seem to be determined at a lower altitude than that which has been considered. Most of the sources have the sense of extraordinary wa though some have an opposite sense at 9400 Mc/s. The degree of polarization increases with frequency; the value for the most acti spot amounts to more than 60% at 9400 Mc/s, while at 1000 Mc/s it is zero.

523

18648 FLUCTUATIONS IN THE INTENSITY OF RADIO EMISSIONS SCATTERED BY CORONAL IRREGULAR TIES.

V.V.Pisareva.

Astron. Zh., Vol. 36, No. 3, 427-33 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, 419-24 (Dec., 1959).

Describes simultaneous observations of solar radio emission made at two points separated in longitude (Gor'kii and Irkutsk) at frequency of 260 Mc/s. The experiment was carried out in order detect fluctuations in intensity of diffractive origin. The observations failed to reveal any fluctuations at a precision of up to 2% o the mean level of solar radio emissions. This circumstance may associated with the fact that radio emission sources on the sun ar of too large angular dimensions. It is shown that observations ma with an aerial having an effective area of the order of 200 m^2, and an equipment with a fluctuation threshold of 2° sensitivity, with a time constant of 1 sec, might have led to the detection of such fluctuations even for wide-angle sources. The variation in the distribution was considered for an angle of radiation passing through a layer containing irregularies, as a function of the distance of the observer to the layer. The results obtained were applied to the scattering of radio emission from Tauri A on coron irregularities. It was found that at great distances from the centre of the sun, the apparent increase in the size of the source could not be explained by scattering on coronal rays. It must be assumed that there also exist irregularities of finer scale in the corona.

523.16 : 550

SOLAR RADIO BURSTS AND GEOMAGNETIC AND IONOSPHERIC DISTURBANCES See Abstr. 18474

523.16 : 550

SIMULTANEOUS OBSERVATIONS OF THE VARIATIONS IN THE HORIZONTAL COMPONENT OF THE EARTH'S MAGNETIC FIELD AND SOLAR RADIO EMISSION. See Abstr. 18469

523.

18649 RADIO IMAGE OF THE MOON AT 8 MM.

N.A.Amenitskii, R.I.Noskova and A.E.Salomonovich.

Astron. Zh., Vol. 37, No. 1, 185-6 (1960). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, 177- (July-Aug., 1960).

A report on the two-dimensional distribution of radio brightn of the moon, obtained using the 22 m radio telescope of the Lebede Physical Institute. A noticeable phase dependence of the radiobrightness distribution, lagging the phase variation of the moon by ~30°, was noted. Limb darkening was also recorded.

523.1

18650 LUNAR RADIO EMISSIONS AT 1.63 cm WAVELENGT

M.R.Zelinskaya, V.S.Troitskii and L.I.Fedoseev.

Astron. Zh., Vol. 36, No. 4, 643-7 (1959). In Russian. English

lation in: Soviet Astron.-AJ (New York), Vol. 3, No. 4, 628-32
-Feb., 1960).
Measurements were made of the temperature of radio emis-
from the central portion of the lunar disk as a function of
phase. The relationship obtained was a sufficiently good
oximation to the expression $T_C = 224 - 36 \cos(\Omega - 40^\circ)$. The
of the e.m. wave attenuation coefficient ($\kappa = 0.2$ cm^{-1}) and
alue of the equivalent conductivity ($\sigma = 7.9 \times 10^8$ c.g.s.e.s.u.)
nar rock, were derived from a comparison with theoretical
ionship.

523.16 : 621.396.96

3651 RADAR DETERMINATION OF THE SCATTERING PROPERTIES OF THE MOON. F.B.Daniels.

re (London), Vol. 187, 399 (July 30, 1960).
To determine the scattering properties of the lunar surface,
istribution in depth of the scattering elements must be considered.
ady of the general problem of reflection from a plane surface
ng random irregularities that are a function both of space co-
nates and time was applied to the case of lunar radio echoes.
C.Hazard

523.16 : 621.396.96

3652 ROUGHNESS OF THE MOON AS A RADAR REFLECTOR. B.H.Briggs.

re (London), Vol. 187, 490; Correction, 466 (Aug. 6, 1960).
Radar and optical measurements of the slope of the lunar
ace both indicate a mean slope of the order of 3°. Smaller
cture appears to have a root mean square value of slope consid-
ly less than 3°.
C.Hazard

523.16

8653 RADIO-SOURCE PROBLEMS. F.Hoyle.

thly Not. Roy. Astron. Soc., Vol. 120, No. 4, 338-59 (1960).
The present paper is based on the theory first proposed by
zburg and Shklovsky that all non-thermal, non-stellar, cosmic
o emission arises from synchrotron radiation by electrons,
rded as secondaries from nuclear collisions of cosmic rays
ambient gas. Evidence for this point of view can be adduced
n the observed radio frequency spectra. The consequences of
nic rays existing (i) in galaxies, (ii) in clusters of galaxies,
in space generally, are examined, on the assumption that the
nic-ray energy density is always ~1 eV cm^{-3}. Considered
rately in the paper are: weak emission from galaxies, clusters,
intergalactic space; strong emission from extragalactic sources;
strong emission from galactic sources. So far as strong
rces are concerned, the argument depends in an important way
he conditions that develop at the shock front of a cloud expan-
at great speed into an ambient medium. The present situation
ers in a curious way from ordinary gas dynamics, in that the
nentum and energy terms of the Rankine—Hugoniot relations
carried by quite different components of the assembly — the
nentum by the material of the gas cloud and the ambient medium,
the energy by a reservoir of relativistic particles and by a mag-
field. To overcome the difficulty that the detailed physical
cesses that take place within the shock front itself are not well under-
d, a rule is proposed that receives strong empirical support from a
range of observed phenomena, including such diverse cases as
radio emission of Cygnus A and the optical emission of the Crab
ula. When the magnetic field dominates in the energy terms, the
s yields results that differ markedly from those given by the
loffman—Teller equations. The field does not preserve a
orm structure at the front, as in the de Hoffman—Teller case,
levelops a highly wrapped, contorted structure — such as is
gested by the observed optical filaments of Casseiopeia A. If
rule were also applicable to cases where the energy and
nentum were carried by different components, the momentum
comparatively high-density, low-temperature gas and the
rgy by a low-density, high-temperature non-relativistic gas
gas considered in the present paper is relativistic) a new
cess would be available for producing very high temperatures.

523.16

8654 ON THE SPECTRA OF RADIO SOURCES. R.G.Conway, J.R.Shakeshaft and G.R.Whitfield.

ervatory, Vol. 80, 162-3 (Aug., 1960).
For radio sources for which the emission spectrum is steeper
igher frequencies, the apparent spectral index between two
d frequencies will become steeper in the presence of a red
shift. It is pointed out that as the majority of the radio sources are probably at distances where red shift effects are important it would be of interest to see if there is an increase in the slope of the spectrum for more distant sources.
C.Hazard

523.16 : 551.5

18655 IONOSPHERIC REFRACTION IN RADIO ASTRONOMY. I. THEORY. M.M.Komesaroff.

Austral. J. Phys., Vol. 13, No. 2, 153-67 (June, 1960).

Expressions were derived for the apparent displacements of cosmic radio sources at transit resulting from ionospheric refraction. The derivation took account of horizontal electron density gradients whose effects often outweigh the refraction expected from a spherically symmetrical ionosphere. Using these results together with position measurements taken at 19.7 Mc/s, the "total thickness" of the ionosphere was estimated. This quantity relates the total electron content of a vertical column to the maximum electron density. During the observing period it had a value of 355 km, in good agreement with moon-echo results. The observations also indicate that a considerable improvement in observed source positions may be achieved by applying the theory.

523.16

18656 ON THE DIMENSIONS, SPATIAL DENSITY, AND POWER OF THE EXTRAGALACTIC RADIO SOURCES.

H.E.C.Tunmer.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 4, 360-3 (1960).

Although the majority of the discrete radio sources are unidentified, it is believed that they are very distant extragalactic objects. They may be galaxies with few visible stars. This paper examines physical conditions in large gas clouds, and shows that if these constitute the major class of radio sources a lower limit may be placed on their radio powers. If a large proportion of the mass is condensed into stars the conditions for gravitational stability, which form a part of the present argument, will not apply; however it appears that even under these circumstances the radio power must exceed 10^{25} W ster^{-1} (c/s)$^{-1}$ at 80 Mc/s.

523.16 : 522

18657 RADIO DATA RELEVANT TO THE CHOICE OF A GALACTIC COORDINATE SYSTEM.

C.S.Gum and J.L.Pawsey.

Monthly Not. Roy. Astron. Soc., Vol. 121, No. 2, 150-63 (1960).

Radio observations relating to the determination of the directions towards the galactic pole and centre are collected and studied. The most important evidence on the direction of the pole is based on 21 cm hydrogen line observations (see preceding abstract); the derived direction is confirmed by observations in the radio continuum. The direction towards the galactic centre is deduced from various continuum and hydrogen line observations, the most precise information being derived from the position of the radio source Sagittarius A which is assumed to be associated with the galactic nucleus and at the galactic centre. The outstanding physical result of this study is the extreme flatness of the disk of neutral hydrogen in its central parts; a new point is the large-scale association between the sources of the radio continuum and the 21 cm line radiation. The significance of the results is discussed.

523.16 : 522

18658 THE POSITION OF THE GALACTIC CENTRE. J.H.Oort and G.W.Rougoor.

Monthly Not. Roy. Instron. Soc., Vol. 121, No. 2, 171-3 (1960).

The direction to the radio source Sagittarius A is found to be within 0°.03 of the direction to the galactic centre as determined from a number of precise optical and radio observations, including the recently discovered rapidly rotating disk of neutral hydrogen around the centre. This, together with the fact that the source is unique among the known sources, makes it highly probable that Sgr A is situated at the centre. Additional evidence comes from the observation of 21 cm absorption lines, which indicate that the distance of Sgr A is equal to or greater than the distance to the galactric centre.

523.16

18659 THE NON-THERMAL EMISSION FROM THE DISK OF THE GALAXY.

R.Hanbury Brown and C.Hazard.

Observatory, Vol. 80, 137-45 (Aug., 1960).

A discussion of the general features to be expected in the distribution of synchrotron emission from a system of spiral arms. The analysis shows that on the assumptions that the emission is largely confined to the arms, is directional and due to an isotropic flux of particles in a magnetic field aligned along the arms, then the observed distributions can be satisfactorily explained. Small steps observed in the latitude distribution are consistent with irregularities in the direction of the magnetic field. C.Hazard

523.16 : 530.12

A GRAVITATIONAL RED SHIFT IN 21 cm RADIATION FROM THE GALAXY. See Abstr. 18912

523.16

18660 AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF CONFUSION IN A SURVEY OF LOCALIZED RADIO SOURCES. C.Hazard and D.Walsh.
Monthly Not. Roy. Astron. Soc., Vol. 119, No. 6, 648-56 (1959).

Radio source surveys were made using both a total power equipment and an interferometer. It is shown that in the regions of sky common to the surveys there are considerable discrepancies between the two lists of sources and the majority of these discrepancies are probably due to confusion effects. A comparison of the lists of sources enables an estimate to be made of the reliability of a confusion-limited survey. This limit seems to occur at about one source per 25 beam areas. Application of this limit to other surveys suggests that the Cambridge 2C survey is severely resolution-limited, and that the apparent increase in the density of sources with distance deduced from this survey must therefore be considered extremely doubtful. The Sydney survey which is compatible with an isotropic distribution of sources seems, however, to be free from serious resolution limitations. The conclusions drawn from this latter survey would therefore appear to be more reliable than those drawn from the Cambridge 2C survey.

523.16

18661 THE SPECTRA OF RADIO STARS.
G.R.Whitfield.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 6, 680-91 (1957).

523.16

18662 OBSERVATIONS OF DISCRETE RADIO SOURCES AT A FREQUENCY OF 500 Mc/s. R.G.Conway.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 6, 692-7 (1957).

523.16

18663 BRIGHTNESS DISTRIBUTION OVER SOME STRONG RADIO SOURCES AT 1427 Mc/s.
R.Q.Twiss, A.W.L.Carter and A.G.Little.
Observatory, Vol. 80, 153-9 (Aug., 1960).

A preliminary account of measurements on some strong radio sources using groups of aerials of the Christiansen "cross" array as an interferometer. Both amplitudes and phases of the individual Fourier components of the brightness distributions were measured. An outline is given of some of the results obtained on Centaurus A, Taurus A, Cygnus A and the Orion nebula. The bright central region of Centaurus A is shown to be complex, and a comparison of the measurements on Cygnus A with measurements at other frequencies confirm that the apparent shape of this source is a function of frequency. C.Hazard

523.16

18664 RADIO EMISSION FROM THE CYGNUS LOOP.
J.E.Baldwin and P.R.R.Leslie.
Monthly Not. Roy. Astron. Soc., Vol. 120, No. 1, 72-8 (1960).

Observations have been made of the Cygnus Loop using the new 178 Mc/s radio telescope at Cambridge. Good positional agreement was obtained between several of the radio and optical features but an intense extended source lying 1° south of the centre of the Loop is not correlated with any outstanding optical feature. The spectral index is −0.6 and it is suggested that, although emission from some parts of the nebula is thermal, the main component is non-thermal.

523.16

18665 A SPECTRAL ANALYSIS OF THE RADIO SOURCES IN CYGNUS X AT 1390 Mc/s AND 408 Mc/s.
D.S.Mathewson, M.I.Large and C.G.T.Haslam.
Monthly Not. Roy. Astron. Soc., Vol. 120, No. 3, 242-7 (1960).

A high resolution survey of the Cygnus X region was made at 408 Mc/s using the 250 ft paraboloid at Jodrell Bank. The results were combined with the high resolution at 1390 Mc/s of Drake a
Westerhout to investigate the spectral characteristics of the indi-
dual radio sources in Cygnus X. The results support the previou
conclusions that the emission is from optically thin H II regions
except for the strongest source in the region, the γ Cygni source
which was found to have a non-thermal component.

52

18666 ON THE NATURE OF THE CYGNUS-X RADIO SOUR
AS DERIVED FROM OBSERVATIONS IN THE CONTINUUM AND AT THE HYDROGEN-LINE FREQUENCY.
R.D.Davies.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 6, 663-79 (1957).

523.

18667 THE SPECTRUM OF THE CYGNUS (19N4A) AND CASSIOPEIA (23N5A) RADIO SOURCES BELOW 30 Mc
A.C.B.Lovell and H.W.Wells.
Monthly Not. Roy. Astron. Soc., Vol. 121, No. 1, 111-14 (1960).

The 250 ft steerable radio telescope and the 220 ft transit ra
telescope at Jodrell Bank have been used as an interferometer to
measure the ratio of the intensities of the Cygnus and Cassiopeia
radio sources from 16.0 to 26.0 Mc/s. The ratio remains consta
at 0.53. The results are compared with previous measurements. The amount of absorption to be expected in H II regions is calculated and it is shown that the difference in H II content along the lines of sight to Cassiopeia and Cygnus cannot be greater than tha
contained in a cloud of extent 4 parsecs and electron density less than 3 electrons/cm^3; which is well below the value normally assumed for an average H II cloud.

523.1

18668 OBSERVATIONS OF THE CRAB NEBULA WITH THE LARGE [HIGH RESOLUTION] RADIO TELESCOPE OF THE PULKOVO OBSERVATORY.
G.P.Apushkinskii and Yu.N.Pariiskii.
Astron. Zh., Vol. 36, No. 4, 739-40 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 4, 717-
(Jan.-Feb., 1960).

Results of preliminary observations on 3 cm are reported. The angular dimensions, the coordinates of the effective centre of
radio emission, and the asymmetry of the source were determine

523.

18669 THE CORONAL ECLIPSE OF THE CRAB NEBULA OBSERVED AT 169 Mc/s. A.Boischot.
Ann. Astrophys., Vol. 22, No. 6, 901-12 (1959). In French.

The eclipse of the Crab Nebula by the solar corona was obser
in 1957 and 1958 with the interferometer of Nancay. At 169 Mc/s,
the E–W dimension of the radiosource increases up to 15 minutes
arc when it approaches the sun. The displacement of its position
certainly smaller than one minute of arc in the E–W direction, bu
an increase of the flux density was observed some days when the source is near the sun.

523

18670 ABSOLUTE FLUX MEASUREMENTS OF CASSIOPEIA
TAURUS A, AND CYGNUS A, AT 3200 Mc/s.
N.W.Broten and W.J.Medd.
Astrophys. J., Vol. 132, No. 2, 279-85 (Sept., 1960).

Measurements of the radio flux density from the three bright
radio sources are described. The flux was determined with refer-
ence to the thermal radiation from a heated load, and the gain of
4 × 3 ft aperture horn antenna. The experimental technique elimi
ed the necessity of determining the background temperature. The
accuracy is examined in detail, and a probable error of 4 or 5% is
assigned to the flux values. In units of 10^{-25} W m^{-2} (c/s)$^{-1}$, value
of flux density for Cassiopeia A, Taurus A, and Cygnus A are, respectively, 134, 71, and 68.

52

18671 AN OCCASIONAL DECREASE IN THE AVERAGE RECEPTION OF CASSIOPEIA A ON 45 Mc/s.
J.Tuominen, I.Tuominen and J.Riihimaa.
Ann. Acad. Sci. Fennicae A VI, No. 61, 9 pp. (1960).

This paper deals with decreases observed by means of a pha
switching interferometer. The phenomenon is found to take place
only when the sun is low below the horizon. It is independent of

th distance of Cass. A. It seems as if it were produced by orption due to some kind of an ionospheric "cloud" which erally is observed first in the north ($\varphi = 67^{\circ}$), then in the south $= 60^{\circ}$), and which very often ceases to exist first in the north then in the south.

523.16

18672 ON THE RATE OF SCINTILLATION OF CASSIOPEIA A ON 45 Mc/s. J.Tuominen, E.Kataja and J.Riihimaa.
. Acad. Sci. Fennicae AVI, No. 62, 20 pp. (1960).

It is assumed that the scintillation of a radio source is produced he motion of the source, as seen from the observer, relative to ospheric irregularities at a certain altitude above the earth's face. If this "grainy" layer of the ionosphere follows the diurnal tion of the earth, at the latitude 60° N Cassiopeia A should tillate at the lower culmination with a rate about twice as high t the upper. Observations seem to indicate, however, that the tillation rate is only about $\frac{1}{4}$ higher at the lower culmination at the upper. If the altitude of the scintillation-producing layer he ionosphere is 300 km (corresponding to the F2-layer), this cates an average ionospheric wind directed toward the east, its ed being 15 km/hr. An altitude of 200 km (F1-layer) would respond to an average speed 10 km/hr and 100 km (E-layer) to of 4 km/hr

523.16

18673 FURTHER OBSERVATIONS OF RADIO STELLAR SCINTILLATION. I.L.Jones.
tmos. terrest. Phys., Vol. 19, No. 1, 26-36 (Sept., 1960).

Observations are described of the scintillation of the radio al received from the radio star in Cassiopeia on a frequency of Mc/s. Further experimental results are presented to support ncer's (1955) evidence that the irregularities responsible for the o stellar scintillation are elongated with their long axes along lines of force of the earth's magnetic field. An estimate of the of the irregularities in the ionosphere is made, and a marked rease in the long axis of the irregularities is found as the elevation of the radio source decreases. Evidence is put forward which gests that turbulence is unimportant on most occasions in the on responsible for the scintillation.

523.16

18674 OBSERVED VARIATIONS IN THE AMPLITUDE SCINTILLATIONS OF THE CASSIOPEIA (23N5A) DIO SOURCE. H.J.A.Chivers.
atmos. terrest. Phys., Vol. 19, No. 1, 54-64 (Sept., 1960).

Continuous monitoring of the radio source in Cassiopeia N5A) on a frequency of 79 Mc/s has made possible an analysis he variations of radio star scintillations observed from Jodrell nk (latitude 53° N). Monthly average daily variations are present- as functions of solar time, and the mean daily variations averaged r a year are evaluated as functions of both solar and sidereal e. An effect due to the geomagnetic latitude at which the observa- ns were made is demonstrated. Since records are available for r 4 years, the variation of scintillations with the sunspot cycle been studied, and it has been found that in years of high solar ivity scintillations show a strong seasonal dependence with ximum activity at the equinoxes. When examined over this long iod, there is a strong negative correlation between scintillations the occurrence of spread-F echoes. Evidence has been obtained t the angular size of the Cassiopeia source is sufficiently large produce scintillations different from those expected of a point rce.

523.16 : 522

18675 A 21-CM DETERMINATION OF THE PRINCIPAL PLANE OF THE GALAXY.
.Gum, F.J.Kerr and G.Westerhout.
nthly Not. Roy. Astron. Soc., Vol. 121, No. 2, 132-49 (1960).

Observations at 21 cm have shown that the neutral hydrogen er is exceedingly flat over the region of the Galaxy within 7 kpc m the centre. The mean plane of the hydrogen in this region st have an important dynamical significance, and may be arded as the principal plane of the Galaxy. The position of this ne has been determined, using data from two extensive surveys he Milky Way by the Leiden and Sydney groups. A number of st squares solutions have been made for the position of the plane. sides the main series of solutions incorporating all the points, ious partial solutions were made for restricted regions of the Galaxy, to obtain additional information about the flatness of the hydrogen layer and the reliability of the observations. Close agreement was obtained between the best solutions, indicating that the region of the Galaxy within 7 kpc from the centre is indistinguishable from a plane. The finally-adopted solution has the following elements and overall probable errors, expressed in terms of Ohlsson's coordinate system: l_0^{I}, the longitude of the north pole of the plane, 347° ± 5°; Δ, the deviation of this pole from Ohlsson's pole, 1°.50 ± 0°.12; z_0, the height of the sun above the plane, 4 pc ± 12.

523.16

18676 AN ATTEMPT TO DETECT THE GALACTIC MAGNETIC FIELD USING ZEEMAN SPLITTING OF THE HYDROGEN LINE. J.A.Galt, C.H.Slater and W.L.H.Shuter.
Monthly Not. Roy. Astron. Soc., Vol. 120, No. 2, 187-92 (1960).

An attempt has been made to determine the strength of the galactic magnetic field by observing the inverse Zeeman effect on the 21 cm absorption line of neutral hydrogen. Preliminary measurements using the Cassiopeia A radio source have shown no detectable Zeeman effect. This indicates that the magnetic field component in the line of sight is less than 5×10^{-5} oersted at the point in the Orion spiral arm where the absorption occurs.

523.16

18677 RESULTS OF A SURVEY OF GALACTIC RADIATION AT 38 Mc/s. J.H.Blythe.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 6, 652-62 (1957).

523.16

18678 THE SPECTRUM OF THE GALACTIC RADIO EMISSION. C.H.Costain.
Monthly Not. Roy. Astron. Soc., Vol. 120, No. 3, 248-55 (1960).

Absolute measurements of the cosmic background radiation have been made at wave-lengths of 1.7 m and 7.9 m. Scaled aerials were used in conjunction with thermally-calibrated receivers in order to make an accurate determination of the spectrum of the emission. Observations by Baldwin at a wave-length of 3.7 m have been smoothed to provide a comparison at an intermediate frequency. The spectral index, x, defined by $T_A \propto \lambda^x$, was found to be 2.37 ± 0.04. There are no significant departures from this value, measured over solid angles of approximately 0.2 steradians, except for regions on the galactic plane within 60° of the galactic centre. The possibility of detecting the extra-galactic component of the integrated emission by means of its spectral index is discussed and upper limits are derived.

523.16

18679 DISTRIBUTION OF METEOR RADIO ECHOES BY DURATION. I. REFLECTION FROM STABLE TRAILS.
E.I.Fialko.
Astron. Zh., Vol. 36, No. 5, 867-73 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 5, 842-8 (March-April, 1960).

The distribution of meteor radio echoes intercepted from a sector is considered with respect to the duration of the reflections. Analytical expressions are derived for the general case and two particular cases. The experiments, on the whole, confirm the results obtained.

523.16

18680 RADIO-ECHO OBSERVATIONS OF SOUTHERN HEMISPHERE METEOR SHOWER ACTIVITY FROM 1956 DECEMBER TO 1958 AUGUST. A.A.Weiss.
Monthly Not. Roy. Astron. Soc., Vol. 120, No. 5, 387-403 (1960).

A further survey of southern hemisphere meteor activity, extending from 1956 December to 1958 August, has been made with the 67 Mc/s narrow-beam equipment. The faintest detectable meteor trail has an electron line density of 1.3×10^{11} electrons/cm. The potentialities of radio equipments for the detection of weak meteor showers are demonstrated by an objective statistical analysis of echo counts. Weaker showers can be detected by the present equipment only if they transit within 30° of the zenith. The statistical analysis reveals an inherent clustering in the ecliptical component of sporadic meteors, and there is some evidence for very weak or short-lived showers which do not satisfy all the criteria laid down for an accepted shower. Radiants and echo rates for fifteen accepted and seven possible showers are tabulated and discussed. Echo rates measured at different equipment sensitivities for four showers indicate in all cases a deficiency, relative to sporadic meteors, in the numbers of fainter meteors in these streams.

523.16

18681 A SOUTHERN HEMISPHERE SURVEY OF THE RADIANTS OF SPORADIC METEORS.
A.A.Weiss and J.W.Smith.
Monthly Not. Roy. Astron. Soc., Vol. 121, No. 1, 5-16 (1960).

A further survey of sporadic meteor activity, from December 1956 to August 1958, has been made with 67 Mc/s narrow-beam equipment operated at a limiting line density close to 10^{11} electrons/cm. Analysis of the echo rates suggests that the sporadic radiant distribution may be sharply divided into two components. One component is concentrated towards the apex and corresponds to a distribution of orbits uniform in heliocentric coordinates except for a moderate preponderance of direct over retrograde orbits. The other component lies close to the plane of the ecliptic, with radiants strongly concentrated in two regions centred on longitudes $\pm 68^0$ from the apex. No change is apparent in the radiant distribution as the limiting sensitivity is lowered from the 3rd to the 7th visual magnitude.

523.16

18682 THE IMPORTANCE OF INITIAL TRAIL RADIUS ON THE APPARENT HEIGHT AND NUMBER DISTRIBUTIONS OF METEOR ECHOES. J.S.Greenhow and J.E.Hall.
Monthly Not. Roy. Astron. Soc., Vol. 121, No. 2, 183-96 (1960).

Some simultaneous radio echo observations of meteors at wavelengths of 8 m and 17 m are described. It is shown that very many more echoes from faint +6 mag. meteors are observed at 17 m than at the shorter wavelength, and this effect is attributed to an attenuation in echo amplitude due to the large initial radii of the ionized trails. The initial radius is found to increase from 1 m to 3 m between the heights of 90 and 115 km. It is estimated that radio echo equipments of moderate sensitivity detect only 1.5% of +6 mag. meteors at a wavelength of 4 m, 8% at 8 m, rising to 40% at 17 m. The influence of this large attenuation in echo amplitude on metre wave radio echo observations of meteor height, mass, and velocity distributions is considered.

523.16

18683 THE DETERMINATION OF THE INCIDENT FLUX OF RADIO-METEORS. T.R.Kaiser.
Monthly Not. Roy. Astron. Soc., Vol. 121, No. 3, 284-98 (1960).

The observed rate of radio-meteors depends on a number of factors which include: (i) the incident flux and distribution in magnitude of the meteors, (ii) the radiant coordinates, (iii) the variation in ionization along a meteor trail, (iv) the nature of the radio reflection process and (v) the parameters of the radio-echo equipment. The present work represents a considerable simplification over previous attempts (see Abstr. 18 of 1954) to relate the radio echo rate to the actual flux of meteoroids. Simple formulae are derived relating these two quantities which, when used together with suitable graphical representation of the directional properties of the aerial system and of the reflection geometry, enable the incident flux of shower meteors to be deduced from the observed rate. The fact that the variation with time of the shower rate obtained with a fixed aerial beam may be predicted is relevant in connection with a method (see Abstr. 4650 of 1958) for a shower radiant determination. Limitations due to the approximations in the theory, and to the simplified ablation theory on which it is based, are discussed.

523.16

18684 RADAR-ECHO OBSERVATIONS OF METEORS USING TWO RECEIVERS OF DIFFERENT SENSITIVITY.
L.A.Katasev, V.N.Korpusov and A.D.Orlyanskii.
Astron. Zh., Vol. 37, No. 1, 115-18 (1960). In Russian. English translation in: Soviet Atron.—AJ (New York), Vol. 4, No. 1, 110-13 (July-Aug., 1960).

Results are given of a study of the S parameter of the mass distribution function for the 1959 Quadrantid shower. It is shown that S did not remain constant, but varied with time, and reached a peak value of 2.96 at about 5^h-7^h U.T. on 4 January 1959. A derivation of a formula for determining the diffusion coefficient D on the basis of radar-echo observations of meteors, using two receivers of different sensitivity, is given.

523.16 : 523.5

THE VARIATION OF METEOR HEIGHTS WITH VELOCITY AND MAGNITUDE. See Abstr. 18715

523.16 : 621.396.

18685 THE SYNTHESIS OF LARGE RADIO TELESCOPES.
M.Ryle and A.Hewish.
Monthly Not. Roy. Astron. Soc., Vol. 120, No. 3, 220-30 (1960).

Many investigations in radio astronomy are limited by the resolving power which can be achieved by conventional methods aerial construction. A new method of obtaining increased resolv power has been developed, which has been applied to the constru of both "pencil-beam" systems and interferometers. In this met two aerials are arranged so that their relative position may be altered to accupy successively the whole area of a much larger equivalent aerial. By combining mathematically the information derived from these different positions, it is possible to obtain a resolving power equal to that of the large equivalent aerial. Sinc the combination of the individual records may be done with differe phase relationships, it is possible, without extra observations, to "scan" the synthesized aerial over an appreciable solid angle; because of this the total observing time of a synthesized instrum is of the same order as that of a conventional instrument. An interferometric system designed for the study of radio stars has been built which has an equivalent area for resolution of 8×10^5 ft^2 as well as a "pencil-beam" system with an equivalent area of 3 × 1 ft^2. The sensitivity of both systems corresponds to a "collecting area" of about 2×10^5 ft^2.

523.

18686 SENSITIVITY OF RADIOTELESCOPES AND CORRELTION RECEIVERS. E.J.Blum.
Ann. Astrophys., Vol. 22, No. 2, 140-63 (1959). In French.

The sensitivity of radiotelescopes is considered, with refere to aerial and receiver characteristics. It is shown that two class of apparatus exist: comparison and correlation radiotelescopes essentially different properties. A discussion of these properties followed by the description of a simple technique, in order to mak measurements by correlation.

18687 OPERATION AT THE "MEDICINA STATION" OF A 327 MHz RADIOTELESCOPE.
A.Braccesi, M.Ceccarelli, G.Mannino, G.Setti and G.Sinigaglia.
Nuovo Cimento, Vol. 17, No. 4, 614-15 (Aug. 16, 1960).

A description of a meridian transit radio-telescope of the Cambridge type. The cylindrical parabolic reflector is 110 m lon and 6.7 m wide, is oriented East—West and can be rotated to cove declinations -15^0 to $+90^0$. The beam width between half-power po is 32' × 7^0. The instrument is primarily a pilot model for an instment working at the same frequency but with a collecting area thi times larger. C.Haza

52

18688 IMPERFECTIONS OF ELASTICITY IN THE SMALL BODIES OF THE SOLAR SYSTEMS. H.Jeffreys.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 5, 506-15 (1957).

18689 ORIGIN OF THE SOLAR SYSTEM.
M.H.Briggs.
Nature (London), Vol. 187, 1102-3 (Sept. 24, 1960).

Some objections are raised to the model of the origin of the solar system proposed by Woolfson (Abstr. 14393 of 1960). This theory postulates a catastrophic interaction between the sun and a second star. Numerous pieces of evidence which cannot be explai by such a hypothesis are cited. J.M.Ba

18690 ON THE ORIGIN OF THE SOLAR NEBULA.
F.Hoyle.
Quart. J. Roy. Astron. Soc., Vol. 1, No. 1, 28-55 (Sept., 1960).

A consideration of star formation from the interstellar gas shows that the primitive solar condensation was probably endowe with angular momentum very much greater than that now possess by the sun. It is found, however, that the initial angular momentu agrees with that possessed by the primaeval planetary material. is suggested therefore that the angular momentum of the solar nebula was transferred to the planetary material. A similar pro of transfer appears to take place generally in dwarf stars. Mass early-type stars, on the other hand, possess the expected angula momentum, and presumably do not have planetary systems. In th solar case, the process of angular momentum transfer was proba hydromagnetic — a field with intensity ~1 gauss being required

ect the sun and the planetary material. As the planetary
rial acquired angular momentum it moved farther and farther
from the solar condensation. Materials of low volatility
ensed out of the gas and were left behind as the main mass of
moved outwards. The fact that the terrestrial planets are (i) of
l mass (ii) composed almost wholly of low volatility materials
on the inside of the system, is attributed to this leaving behind
e low volatility materials. Various subsidiary problems, such
e formation of satellites, and the escape of gas from the
phery of the solar system, are briefly discussed.

523.2 : 537.59

COSMIC-RAY INTENSITY VARIATIONS AND THE INTER-
NETARY MAGNETIC FIELD. See Abstr.17452

523.2 : 550.3 : 551.5 : 537.59

A UNIFIED THEORY OF TERRESTRIAL AND SOLAR MAGNETI-
ION, THE OUTER VAN ALLEN BELT AND HIGH ENERGY
MARY COSMIC RAYS. See Abstr. 18473

523.3

8691 THE DURATION OF INTENSE BOMBARDMENT PROCESSES ON THE MOON. H.C.Urey.

ophys. J., Vol. 132, No. 2, 502-3 (Sept., 1960).

A critical discussion of the main arguments advanced in the
decade to explain the relatively short period of intense
bardment of the lunar surface (between 10^3 and 10^4 yr). The
estion here is that the short-period formation of the lunar
ria" is in accord with the author's hypothesis that the moon was
ured by the earth at a late stage in the formation of the latter by
apture of smaller objects. D.R.Barber

523.3

8692 THE SECULAR ACCELERATION OF THE MOON, AND THE LUNAR TIDAL COUPLE. C.A.Murray.

hly Not. Roy. Astron. Soc., Vol. 117, No. 5, 478-82 (1957).

523.3

8693 THE LUNAR SURFACE AS AN IMPACT COUNTER. E.J.Öpik.

hly Not. Roy. Astron. Soc., Vol. 120, No. 5, 404-11 (1960).

The dust cover of the moon stocks to mountain slopes and
ot possess any degree of fluidity. It is probable that only a
ed migration of the dust from the slopes into adjacent valleys
s place, caused by meteor bombardment. The material of the
rometeors cannot escape from the Moon and is expected to
a layer of the order of 40 g/cm^2, accumulating over the
ia and protecting them from further erosion by small meteors.
e meteorities are not stopped by the dust and produce meteor
ers; at a velocity of 20 km/sec the ratio of crater to projectile
eter is estimated to be about 20. 812 crater diameters, meas-
over an area of 465 000 km^2 in Western Mare Imbrium, show
quency distribution which is close to that predicted from the
ent population of interplanetary space and a time interval of
< 10^9 years. It is concluded that since the formation of Mare
rium the population of interplanetary space has not changed
eciably; a tentative explanation is given.

523.3

8694 THE DIFFERENCE IN THE SPECTRAL PROPERTIES OF AREAS ON THE LUNAR SURFACE. V.G.Teifel'.

on. Zh., Vol. 36, No. 6, 1041-6 (1959). In Russian. English
slation in: Soviet Astron.—AJ (New York), Vol. 3, No. 6, 955-9
-June, 1960).

The results of spectrophotometry is measurement of 90 lunar
s in the range 390-620 mμ are considered. The spectral curves
hese areas, constructed relative to a reference area in Mare
rum, are characterized by an almost monotonic variation of
sity along the spectrum, and this allows the colour indices to
sed for the determination of the colour of lunar objects. The
imum difference in the spectral curves, expressed in relative
trophotometric gradients, is 0.57 for 390-500 mμ and 0.72 for
620 mμ, i.e. it does not exceed 0.6 of the spectral class dG.

523.3

18695 COLOR CONTRASTS OF THE LUNAR SURFACE. N.P.Barabashov, V.I.Ezerskii and V.A.Fedorets.

ron. Zh., Vol. 36, No. 3, 496-502 (1959). In Russian. English
slation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3, 484-9
., 1959).

The photographic spectrophotometric method was employed for investigating the spectral reflecting properties of details of the lunar surface. The colour contrasts in the usual system of colour indexes are $0^{\mathrm{m}}.2-0^{\mathrm{m}}.3$. In the majority of cases, the relation between ΔCI and $\Delta \log I_{550}$ is close to linear, $(\Delta CI/\Delta \log I_{550})$ being $\cong 0.6$.

523.3

18696 A STUDY OF THE ROCKS MOST CLOSELY RESEMBLING THE SURFACE CONSTITUENTS OF THE MOON. N.P.Barabashov and A.T.Chekirda.

Astron. Zh., Vol. 36, No. 5, 851-5 (1959). English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 5, 827-31 (March-April, 1960).

On the basis of photometric and spectrophotometric observations of rock species found on the earth and the moon, and on the basis of other characteristics, it was found that the lunar surface does not resemble a fused surface, but most probably it is covered with disrupted tuffaceous rock, and in some places by coarse-grained volcanic ash.

523.3

18697 THE MOON'S LIBRATION IN LONGITUDE. H.Jeffreys.

Monthly Not. Roy. Astron. Soc., Vol. 117, No. 5, 475-7 (1957).

523.3

18698 EARTH SATELLITES AND LUNAR FORMATIONS. C.O.R.Jaschek.

Observatory, Vol. 80, 119-20 (June, 1960).

It is proposed that the lunar craters were formed at an early stage of lunar history by impact of a large number of small earth-satellites whose mass distribution was similar to that of the asteroids. Quantitative data from Baldwin (1949), Young (1940), Urey (1956), and Kuiper (1958) for lunar craters, and asteroids lead to a probable mass distribution coefficient of 1.6, and so confirm the validity of the impact theory. D.R.Barber

523.4

18699 THE DICHOTOMY OF THE VENUS DISK. E.Schoenberg and W.Sandner.

Ann. Astrophys., Vol. 22, No. 6, 839-44 (1959). In German.

The dichotomy of the planet Venus is always observed at a phase angle different from 90°, advanced for eastern elongations, retarded for western elongations, the mean difference being 5 days, corresponding to a phase angle of 86°. Without an atmosphere, the planet would have to present a definite curvature of the terminator. The fact that on the contrary it appears straight is explained in terms of the diffusion of light in Venus's atmosphere, according to a theory of refraction and diffusion. Careful micrometric measures, with and without a red filter, of both diameters of the planet, would seem to furnish a test of this explanation.

523.4

18700 THE EMISSION SPECTRUM OF THE NIGHT SIDE OF VENUS. B.Warner.

Monthly Not. Roy. Astron. Soc., Vol. 121, No. 3, 279-83 (1960).

The measurements given by Kozyrev of features in the spectrum of the night side of Venus are examined. The existence of nitrogen bands is confirmed and evidence is presented identifying emission lines of neutral and ionized oxygen.

523.4

18701 THE ABSOLUTE BRIGHTNESS OF THE B-RING OF SATURN. M.S.Bobrov.

Astron. Zh., Vol. 36, No. 5, 863-6 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 5, 839-41 (March-April, 1960).

The results of photographic photometry reported by Lebedinets (1957) are discussed. It is shown that the value 0.43 obtained by Lebedinets for the absolute brightness d_B (O) of the most intense region of the B-ring is underestimated; it should be $b_B(O) = 0.51 \pm 15\%$.

523.4

18702 DETERMINATION OF THE RIGHT ASCENSION OF THE PLANET SATURN, 1959. A.Vassallo.

Mem. Soc. Astron. Ital., Vol. 31, No. 1, 39-42 (1960). In Italian.

This paper gives the results of the meridian observations of Saturn in R.A., made in the period 17 August-22 September, 1959, with the Bamberg transit instrument of the Capodimonte Observatory. The period of observation includes a date of inversion

(Sept. 5.238) of Saturn's apparent motion, and so permits some considerations on the (O–C) behaviour, also evident in the diagram.

523.4

18703 **DETERMINATION OF THE RIGHT ASCENSION AND SEMIDIAMETER OF THE PLANET MARS.**
E.Proverbio.
Mem. Soc. Astron. Ital., Vol. 31, No. 1, 75-81 (1960). In Italian.

The results are given of astronomical observations of the planet Mars, made with a transit instrument for the determination of the right ascension and of the half-diameter.

523.4 : 525

18704 **THE SECULAR ACCELERATIONS OF SATELLITES.** H.Jeffreys.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 6, 585-9 (1957).

523.4 : 551.5

18705 **THE INFRARED REFLECTIVITY OF A PLANETARY ATMOSPHERE.** J.S.Goldstein.
Astrophys. J., Vol. 132, No. 2, 473-81 (Sept., 1960).

The reflectivity equation for a non-homogeneous stratified atmosphere is solved by an iteration procedure. This method of solution permits averaging over frequency in a straightforward manner suitable for use in the infrared absorption bands, where the exponential law of attenuation does not hold for detectors of finite band width. The emission of such an atmosphere is also shown to be expressible in terms of the measured attenuation function. The separate consideration of emission and scattering will be valid only in a limited spectral region.

523.5

18706 **A METHOD FOR STUDYING THE MASS DISTRIBUTION OF METEORIC BODIES.** E.I.Fialko.
Astron. Zh., Vol. 36, No. 6, 1058-60 (1959). In Russian. English translation in: Soviet Astron.-AJ (New York), Vol. 3, No. 6, 970-3 (May-June, 1960).

The method utilizes the time distribution of persistent radio echoes from meteor trails. The application of the method to the Perseid shower is discussed.

523.5

18707 **USE OF THE PHOTOGRAMMETRIC METHOD IN DETERMINING THE SPATIAL COORDINATES OF POINTS ON A METEOR TRAJECTORY.** N.D.Rozenblyum.
Astron. Zh., Vol. 36, No. 6, 1061-72 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 6, 974-85 (May-June, 1960).

Outlines the principles and describes the use of stereophotogrammetric instruments in meteor astronomy. In comparison with the "classical" approach, the method proposed here is much simplified and saves time in the reduction of meteor plates taken on a common baseline; identical results are obtained. The stereophotogrammetric technique was applied only to the case where meteors were photographed at zenith. However, it is equally applicable to the general case.

523.5

18708 **SOME NOTES ON VISUAL AND TELESCOPIC METEORS.** J.H.Botham.
Monthly Notes Astron. Soc. S.Africa, Vol. 19, No. 8, 110-13 (Aug. 31, 1960).

Tabular and graphical data are given for naked-eye (1951-58) and telescopic (1958-59) meteor observations made by the Johannesburg Moonwatch team, and others. Both sets of data show the increase of ~ 2.5 times per magnitude step found by Millman (1957) from an analysis of 30 000 records. The Johannesburg results show quite clearly that the major showers do not appreciably contribute to the total of telescopic meteors. D.R.Barber

523.5

18709 **LIGHT CURVES OF METEORS.** R.Ananthakrishnan.
Nature (London), Vol. 187, 675-6 (Aug. 20, 1960).

The conventional luminosity equation for the brightness of a meteor trail contains the constant, τ_0. If better agreement with observational data is required, this term needs to be modified by taking account of the interaction between the ablated meteoritic atoms and the air molecules. Here, τ_0 is replaced by a parameter that varies along the length of the meteor trail and is strictly proportional to the density of the atmospheric environment at eve point. Agreement between theory and observation is then satisfactory, whereas the conventional theory leads to too high a value for the length of the observed trail. D.R.Ba

5[illegible].5

18710 **THE SPECTRUM OF AN ASTEROIDAL METEOR FRAGMENT.** I.Halliday.
Astrophys. J., Vol. 132, No. 2, 482-5 (Sept., 1960).

A study has been made of an unusual meteor spectrum which contains only lines of neutral ion and a weak continuum. The abs of the D lines of sodium is particularly noteworthy and supports meteoric, rather than atmospheric, origin for sodium in normal meteor spectra. The atmospheric velocity was only 13 km/sec. The orbit has a short period, small eccentricity, and low inclinat to the ecliptic. The evidence indicates that the meteoroid must h been a nickel-iron fragment of asteroidal, rather than cometary, origin.

[illegible]5

18711 **"SPORADIC SHOWER" PROPERTIES OF VERY SMAL METEORS.** P.B.Gallagher and V.R.Eshelman.
J. geophys. Res., Vol. 65, No. 6, 1846-7 (June, 1960).

Describes the results of a series of daily radar measuremen of ionized trails produced by meteors as small as the 15th order visual magnitude. The distribution of meteoric dust in the solar system and its effect on the earth's upper atmosphere are exami S.J.St-Lor

523

18712 **FORMATION OF AN IONIZED METEOR TRAIL.** V.P.Dokuchaev.
Astron. Zh., Vol. 37, No. 1, 111-14 (1960). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, 106- (July-Aug., 1960).

The distribution of the ionized gas in the wake of a meteor trail through the upper layers of the atmosphere is discussed. A solution is found for the diffusion equation in the presence of an i source travelling at constant velocity at a small angle to the horiz It is shown that the plasma concentration in the vicinity of the moving meteor is appreciably greater than in the remainder of the meteor wake. The conditions under which the trail may be approx mated to a cylinder with a Gaussian distribution for the plasma concentration with radius are found.

523.

18713 **THE ANTIRADIANT OF A METEOR STREAM.** P.V.Makovetskii.
Astron. Zh., Vol. 36, No. 3, 487-90 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3, 475-8 (Dec., 1959).

The deformations in the meteor-stream density due to the gravitational forces of a planet which crosses the stream is discussed. A zone of increased density of meteors is formed near th planet in a direction opposite to the radiant, this zone being of danger to space ships. Observations of the occultation of the radia by the moon can give new data on the parameters of the stream an the atmosphere of the moon.

523.

18714 **THE ROLE OF RESONANCE EFFECTS IN THE MEASUREMENT OF METEOR VELOCITIES.**
É.K.Nemirova.
Astron. Zh., Vol. 36, No. 3, 481-6 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3, 470-4 (Dec., 1959).

Some features of resonance scattering of radio waves by mete trails are considered. An estimate is made of the influence of resonance on the form of the diffraction pattern and on the accura of the measurement of meteor velocities by the pulse-diffraction method.

523.5 : 523.

18715 **THE VARIATION OF METEOR HEIGHTS WITH VELOCITY AND MAGNITUDE.**
J.S.Greenhow and J.E.Hall.
Monthly Not. Roy. Astron. Soc., Vol. 121, No. 2, 174-82 (1960).

The variation of the heights of occurrence of meteors, with velocity and magnitude are compared with the theoretical predicti The photographic observations are shown to be in good agreement theory over the range of zenithal visual magnitudes from −3 and for velocities of 13 to 70 km/sec. Very large departures the predicted heights are found for radio echo observations magnitude meteors. Reasons for these departures are ıssed.

523.5

716 AN APPROXIMATE ESTIMATION OF THE PROBABILITY OF METEORIC IONIZATION.

Fialko.

on. Zh., Vol. 36, No. 3, 491-5 (1959). In Russian. English slation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3, 83 (Dec., 1959).

Gives an approximate estimate of the exponent n, which occurs ıe relationship between the probability of ionization and the eor velocity.

523.5

18717 MEAN HOURLY RATE OF METEORS RECORDED BY RADAR. I. METEOR STREAM. E.I.Fialko.

on. Zh., Vol. 36, No. 4, 626-8 (1959). In Russian. English slation in: Soviet Astron.—AJ (New York), Vol. 3, No. 4, 14 (Jan.-Feb., 1960).

A general expression is derived for the number of meteors cted by radar under conditions of normal reflection (scattering) adio waves by an ionized trail in a meteor stream. A simplified nula for making the calculations is deduced.

523.5

8718 ON THE STRUCTURE OF THE GEMINID METEOR SHOWER. B.L.Kashcheev and V.N.Lebedinets.

on. Zh., Vol. 36, No. 4, 629-40 (1959). In Russian. English slation in: Soviet Astron.—AJ(New York), Vol. 3, No. 4, 615-25 .-Feb., 1960).

Measurements were made of meteor activity during the epoch e Geminid meteor stream, from 10 to 19 December, 1958. mass distribution of sporadics was found to be $N = N_0/m^2$. The imum of the shower was observed during the night of 13-14 December. The maximum hourly rate of the occurrence of meteors 945. At the moment of maximum activity, the distribution of eoric bodies according to mass changed abruptly, and an increase ıe number of large particles was observed. The central condenon has a cross-section measuring over 5×10^5 km. Distribution rding to mass in the middle of the stream is $N = N_0/m^{1.3}$ at 0.02 g and $N = N_0/m^{2.2}$ at $m < 0.02$ g. On 12 December, from 2^h, the earth passed through a condensation of large meteoric es in the stream. A maximum was observed for the large parti- only. The transverse section of the condensation is estimated $\times 10^5$ or at 5×10^4 km.

523.5

719 THE STRUCTURE OF THE QUADRANTID METEOR STREAM. B.L.Kashcheev and V.N.Lebedinets.

on. Zh., Vol. 37, No. 1, 119-22 (1960). In Russian. English slation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, 17 (July-Aug., 1960).

The results of measurements of the number and duration of eor radio echoes recorded at Kharkov, in January, 1959, are . The distribution of meteors with respect to duration shows the largest particles are concentrated in the central condensa- of the Quandrantid stream. The maximum of the number of icles colliding with the earth occurs later in time, the larger particles considered. The mass distribution of meteoric es shows that there is apparently some lower limit to the mass articles retained in the stream. The same distribution pattern bserved in the case of meteoric particles belonging to the ninid shower.

523.5

8720 CONFIRMATION OF THE ABNORMALLY HIGH Xe^{129} CONTENT IN THE RICHARDTON METEORITE.

gner.

aturforsch, Vol. 15a, No. 8, 748-9 (Aug., 1960). In German.

Gives details of the apparatus and the experimental procedure loyed, and concludes, in good agreement with Reynolds tr. 4041 of 1960), that there is an enrichment of atmospheric y at least 40% Xe^{129}. E.W.Kellermann

523.5

3721 ON THE NATURE OF ZODIACAL LIGHT AND ITS PROBABLE CONNECTION WITH ASTEROIDS AND IODIC COMETS. V.G.Fessenkov.

Ann. Astrophys., Vol. 22, No. 6, 820-38 (1959).

It is shown that the observed particularities of the Zodiacal light including its polarization can be accounted for by the scattering of solar light by the fine interplanetary dust particles if only their properties are the same as that of aerosols always present in the high atmosphere. The supposition about the scattering of light by free electrons is without any observational foundation. Consequently the presence of gas in the interplanetary space cannot be revealed photometrically. The general view of the zodiacal isophotes is almost independent on the character of diffusion function but is intimately connected with the origin of the Zodiacal light. Taking the distribution of asteroids or periodic comets according to their angles of inclination, it is possible to deduce the theoretical isophotes of the Zodiacal light. The complex of periodic comets represents the observations fairly well but in the case of asteroids an improbably high velocity of dust particles at the moment of disintegration must be assumed.

523.5

18722 PHOTOELECTRIC OBSERVATIONS OF THE ZODIACAL LIGHT IN EGYPT. N.B.Divari and A.S.Asaad.

Astron. Zh., Vol. 36, No. 5, 856-62 (1959). In Russian. English translation in: Soviet Astron—AJ (New York), Vol. 3, No. 5, 832-8 (March-April, 1960).

Reports photoelectric observations of the zodical light conducted in October and November, 1957 near Aswan (Egyptian sector of the United Arab Republic). Isophotes of the zodical light were based on observations using yellow and green filters using an interference filter centred on λ 522 mμ. The axis of the zodiacal light proved to lie very close to the ecliptic. The decrease in brightness in the direction perpendicular to the ecliptic proceeded more rapidly in the southerly than in the northerly direction. However, broadening of the isophotes of the order observed at intermediate latitudes was not observed. The maximum degree of polarization was 22%. The mean colour index was + 0.35.

523.6

18723 ON THE NATURE OF "SYNCHRONIC" FORMATIONS IN COMETS' TAILS. S.K.Vsekhsvyat-skii.

Astron. Zh., Vol. 36, No. 3, 503-11 (1959). In Russian. English translation in: Soviet Astron.-AJ (New York), Vol. 3, No. 3, 490-8 (Dec., 1959).

It is shown that the bands observed in the tails of some bright comets (1744, 1858 VI, 1910 I, and others), termed "synchrones" by Bredikhin, could not have been formed by simultaneous ejections of dust particles from the nucleus of the comet, because of: 1) the short lifetime of the bands; 2) the regular sequence of bands in tails; 3) the disagreement between the directions of the bands and the theoretical direction obtained from the mechanical theory; 4) the doublet structure of the bands. The system of bands observed in the type II tail of the comet 1957d Mrkos was studied. A rapid variation of the bands was found, which cannot be explained from the point of view of the mechanical theory, there being a marked discrepancy between their direction and those of the theoretical synchrones. A close similarity between the structure and other features of the "synchrones" in comets and rays of the polar solar corona, suggests electromagnetic nature of these formations. "Synchrones" may be the manifestation of the magnetic field of the solar system or frozen-in lines of force carried by corpuscular streams. It is shown that the magnetic-field strength in the tail of the Mrkos comet may have been less by a factor of ten than that of the solar corona. It is noted that many structural features in type I tails and, in particular, ray systems in comets, can be explained only as the result of electromagnetic processes in cometary plasma.

523.6

18724 THE DISTRIBUTION OF THE JOVIAN GROUP OF COMETS. II. THE SPATIAL PROBLEM.

K.A.Shteins.

Astron. Zh., Vol. 36, No. 3, 512-23 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3, 499-509 (Dec., 1959).

For Pt I, see Astron. Zh., Vol. 34, 86 (1957). The formulae for determining the distribution functions of the major axes a, the parameters p and the inclinations i of the orbital planes have been derived for short-period comets in two different variants. In the so-called hydrodynamic variant a continuous stream of comets was considered. This method was used by H.A. Newton (1891). The reason for the unsatisfactory agreement of Newton's results with observations is given. In the second variant which was used by Fesenkov (1947), the individual properties of the cometary orbits were taken into account during capture. For long-period comets it was assumed that the poles of the orbits, the ascending nodes and the distances of the perihelions from the ascending nodes were distributed uniformly on the celestial sphere and that the perihelions were distributed uniformly in space. The disintegration of comets and the probability of detection of short-period comets (determined empirically) were also taken into account. The results were in good agreement with observations. In both cases three main properties of the distributions were found: 1) a decrease in the number of comets with increasing values of the major axes, 2) a concentration of comets for a given value of a, p having the maximum possible value, 3) the absence of comets with retrograde motions and the concentration of almost all of the comets in the interval of i from 0° to 25°.

523.6

18725 STUDY OF THE λ 3883 CN BAND IN THE SPECTRUM OF THE COMET MRKOS 1957 d. J.Hunaerts.

Ann. Astrophys., Vol. 22, No. 6, 790-811 (1959). In French.

A thorough investigation of the fluorescence mechanism in the λ 3 883 band of CN in Comet Mrkos 1957 d has been carried out. The high resolution spectrograms taken at Palomar Observatory by Greenstein may be fully interpreted: (1) by the Swings effect which may be applied with a high precision; (2) by a secondary effect which may be called the "Greenstein effect" of which a detailed study has been made; a tentative explanation of this effect by the rotation of the cometary nucleus is suggested. On account of the small heliocentric distance (r = 0.60 A.U.) of the comet, it was not possible to make the usual calculations based on successive absorption and emission processes. Instead an initial Boltzmann distribution based on $T = 375\ r^{-1/2}\ ^\circ K$ was utilized and justified. In addition, the investigation has made it possible: (1) to point out the presence of the 1—1 band and to determine the intensity ratio $I(1-1)/I(0-0) = 0.15$; (2) to obtain the intensity variation of the reflected solar spectrum with nucleocentric distance; (3) to establish the probable presence, within the CN band, of two lines of the R-branch of the $B^2\Sigma - X^2\Pi$ system of CH.

523.6

18726 THE ELEMENTS AND EPHEMERIS OF COMET WIRTANEN 1948 b. P.Herget.

Astron. J., Vol. 65, No. 6, 385-6 (Aug., 1960).

A numerical integration and orbit correction are made for the orbit of Periodic Comet Wirtanen 1948 b. The orbit correction is based on 23 observations, nine in 1948, 14 in 1954. The ephemeris for the 1961 apparition is furnished.

523.6

18727 PHOTOMETRY OF THE COMET AREND-ROLAND, 1956h.

G.A.Manova, O.D.Dokuchaeva, B.A.Vorontsov-Vel'yaminov.
Astron. Zh., Vol. 36, No. 6, 1053-7 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 6, 965-9 (May-June, 1960).

Isophotes of the head of the comet (based on plates taken in photographic light on 24-25 April, 1957) and photometric cross-sections through any cometary nucleus are given. It is concluded that the comet had two heads. The inner head, with rather well defined edges, is connected to streams of a type I tail. The second, or outer head, is of parabolic shape, with fuzzy edges connected to a type II tail. This is at variance with the view that the heads of comets possessing type I tails have diffuse boundaries, while comets having type II tails are supposed to have heads with sharply defined envelopes. The brightness distribution sunward throughout the head may be represented roughly by the inverse relationship r^{-1}, which provided an excellent representation of the coma of Whipple's comet 1942g over the entire sunward hemisphere. The r^{-1} relation has no validity at all in the case of the comet Arend-Roland, in directions perpendicular to the sun—comet radius vector.

523.6

18728 POLARIZATION MEASURES OF COMET AREND-ROLAND (1956h) AND COMET MRKOS (1957d).

M.K.V.Bappu and S.D.Sinvhal.
Monthly Not. Roy. Astron. Soc., Vol. 120, No. 2, 152-62 (1960).

Measurements of polarization of Comet Arend-Roland and of Comet Mrkos made photoelectrically, using interference filters and conventional B,V filters are given. The interference filters were chosen to isolate the Na emission at 5890 A and the continu at 4800 A and 4300 A. The polarization at 4800 A in both comets similar yielding a mean value of 20.1% computed for a phase ang of 90°. This indicates that the agencies responsible for the continuum were identical in both comets. The polarization of Na emission calculated for a phase angle of 90° for Comet Mrkos wa 37.4%, in agreement with the theoretical value for Na resonance radiation.

523.6 : 535

18729 A STUDY OF THE MONOCHROMATIC POLARIZATI OF COMET AREND—ROLAND (1956h).

D.E.Blackwell and R.V.Willstrop.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 6, 590-9 (19597).

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18730 ACCELERATIONS IN THE TAIL OF THE COMET 1956h (AREND-ROLAND). G.K.Nazarchuk.

Astron. Zh., Vol. 36, No. 4, 719-22 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 4, 698 (Jan.-Feb., 1960).

The accelerations were determined from the motion of cloud formations and irregularities in the tail. It was established that 27 and 30 April and 2 May, 1957, repulsive forces of the order of 850-2500 units of solar attraction acted on particles in the tail of the comet. The particle velocities in the tail increased with the radius vector. The accelerations due to the repulsive force increased at first and then decreased with increasing radius vector the particles. Large particle accelerations in the cometary tail have been due to the effect of a corpuscular stream escaping fro prominence. The identification of the prominence with the positi of the comet was made by projecting the comet on to the solar dis

523

18731 SOLAR PERIODICITIES.

H.Grenat.
Ann. Astrophys., Vol. 23, No. 2, 262-77 (1960). In French.

The transform of spot area S into $W = 10\ S^{1/3}$ allows the appl cation of the usual laws of statistics. The undecennal period is t of a constant amplitude. Among the 7 periods 1875-1955, 5 have a 10.3 years years duration, and 2 a little longer. The main peri is accompanied by harmonics 1/2, 2, 4, 8, 16. This description does not give any account for other possible short periods.

523.74 : 523.1

18732 A STUDY OF A SOLAR ACTIVE REGION USING COMBINED OPTICAL AND RADIO TECHNIQUES.

W.N.Christiansen, D.S.Mathewson, J.L.Pawsey, S.F.Smerd, A.Boischot, J.F.Denisse, P.Simon, T.Kakinuma, H.Dodson-Prince and J.Firor.
Ann. Astrophys., Vol. 23, No. 1, 75-101 (1960).

Combined optical and radio techniques were used to study a solar active region (C.M.P. 3-4 December 1957, 18° S). The radi observations were made by means of highly directional grating-type arrays operating at wavelengths of 7.5, 21, 88 and 176 cm. The results support the hypothesis that the slowly varying component of the sun's radio emission is thermal in origin and has it source in dense regions which are at about normal coronal temperatures; these regions invariably overlie plages and extend radially outward. The observations have been used to derive the electron densities and temperatures in the selected region. Between heights of 10 000 km and 300 000 km above the photosphe the electron densities in the region are about 3 times the normal (Baumbach—Allen) densities, and are in good agreement with opti measurements of the K-corona in the height range 100 000 to 300 000 km above similar active regions on the sun. The derived electron temperatures are $1.5 \times 10^6\ ^\circ K$ at 300 000 km rising to $2 \times 10^6\ ^\circ K$ at 15 000 km and then falling rapidly to 1 or $2 \times 10^5\ ^\circ$ at about 10 000 km. These temperatures are similar to those tha have been determined for the "quiet" sun and give further confir tion of the thermal nature of the "slowly varying" radio emission

523

18733 MOTIONS IN THE SUN AT THE PHOTOSPHERIC LE VIII. SOLAR ROTATION AND PHOTOSPHERIC CIRCULATION. H.H.Plaskett.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 3, 197-212 (1959).

For Pt VII, see Monthly Not. Roy. Astron. Soc., Vol. 116, No.

1956). From spectra exposed 1953 April 21-23, sight-line
ities have been measured at 332 points over the visible surface
sun. For any point the sight-line velocity can be expressed as
ear function of velocity components directed to the west and the
. Least-squares solutions of such observation equations for
us latitudes reveal as asymmetry of rotational velocities in
quatorial zone and the presence of meridional currents. These
ons suggest the existence of a circulation in the photosphere
lar to that shown in the upper atmosphere of the earth. This
thesis is examined in the light of an investigation by Lighthill
tr. 1392 of 1955) and an observational test is proposed.

523.74

734 THE EXPRESSION FOR THE SOLAR ACTIVITY AS A FUNCTION OF RISE TIME. J.Xanthakis.

Astrophys., Vol. 22, No. 6, 855-76 (1959). In French.

The maximum of the solar activity (areas of sunspots, umbrae,
lae, and Wolf numbers) is established analytically as a function
time of rise. The latter is expressed in solar synodic ro-
ns or in months. It is also shown that the maxima of the solar
ity (areas and Wolf numbers) as well as their mean values per
obey a parabolic law. In certain cases the deviations from
law do not seem to be fortuitous, but to be periodic functions of
g period. The mean daily areas of sunspots are studied in a
nd part for each year from 1879 to 1953, as are the Wolf num-
from 1755 to 1953. In this case the analytical representation
e curves of the solar activity is given as a function of the time
se expressed in years. Further, the following are examined:
he distribution of the secondary maxima and minima of the solar
ity as a function of the time of rise. (b) The ratio N/(N + S),
e N and S represent the total areas of the spots for each cycle
e northern and the southern part of the solar equator respec-
y. (c) The asymmetry N/S of the two hemispheres. (This can
xpressed as a function of the time of rise, and for one periodic
the period is 7 solar cycles).

523.74

35 THE SIGNIFICANCE OF THE CORRELATION COEFFICIENTS OF THE VELOCITIES OF LATITUDE LACEMENT OF NON-RECURRENT SUNSPOTS FOR ERAL YEARS. M.A.Klyakotko.

on. Zh., Vol. 36, No. 3, 550-1 (1959). In Russian. English
slation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3,
6 (Dec., 1959).

An estimate is made of the probability that the correlation
icients of the velocities of latitude displacement of non-
rrent sunspots for a number of years arise purely by chance.
shown that this probability is small, i.e. the coefficients are
spurious quantities, which confirms the presence of structure
e velocity field describing the motion of non-recurrent sunspots
the latitude.

523.74

736 THE EAST—WEST ASYMMETRY OF SPOT-FORMATION ACTIVITY OF THE SUN.

Romanchuk and T.P.Kudinova.

on. Zh., Vol. 36, No. 4, 743-5 (1959). In Russian. English
slation in: Soviet Astron.—AJ (New York), Vol. 3, No. 4, 721-3
-Feb., 1960).

The weak points in the results obtained by Gleissberg and by
meier, concerning the explanation of the east—west asymmetry
e appearance of spot groups, are pointed out. In order to
date the nature of the east—west asymmetry, an attempt was
to study the character of the spot-group distribution over the
disk, taking into account the peculiarities of the development
ch group. Greenwich data for 1935, 1937 and 1939-1946 were
. In the study of the spot-group development it was assumed
the development of the areas during the first days of the exist-
of the spots was linear. The existence of an east-west
metry in the appearance of groups during 1935, 1937 and 1939-
was confirmed, showing that the asymmetry is not due to the
ts of rotation, projection, or the development of spots, but
ars as a result of the distribution of centres of spot formation,
ature of which should depend on physical conditions.

523.74

737 THE SPATIAL ANALYSIS OF MAGNETIC FIELDS IN SUNSPOTS. P.J.Treanor.

thly Not. Roy. Astron. Soc., Vol. 120, No. 5, 412-29 (1960).

A review of existing methods of determining the strength and direction of magnetic fields in sunspots, as a function of position and depth within the spot shows that these have given fragmentary and somewhat discordant results. In particular, little is known of the direction of the magnetic vector. A new method of determining this quantity is described. By means of a Babinet compensator, polarization fringe systems are produced in the components of a normal Zeeman triplet. From the phase difference of σ-component fringes, the constants of the elliptical polarization at each point in the spot are determined, and the orientation of the lines of force deduced. The method minimizes the effect of instrumental polarization; the reduction is simple and fairly short. An experimental test on four sunspots has been carried out, using the Oxford 35 m solar tower and 12 m spectrograph with a Babcock grating. Measurements of field direction were made, using the triplet λ6173 (Fe I); the associated field strengths were determined from the same line and from λ6149, a weak line of FeII. The resulting field-strength variation is in agreement with Broxon's parabolic law, but in contrast with Joy and Nicholson's measures of direction, 40 per cent of the flux is found to be confined within a cone of unit solid angle. Comparisons of field-strength at λ6173 (Fe I) and λ6149 (Fe II) suggest that the gradient in depth does not exceed 1 oersted/km.

523.74

18738 THE EFFECT OF SUNSPOT MAGNETIC FIELDS ON THE GROWTH CURVE. A.I.Kornilov.

Astron. Zh., Vol. 37, No. 1, 182-4 (1960). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, 174-6 (July -Aug., 1960).

Growth curves based on the V I and Fe I lines were plotted for the large sunspot of 14 July 1953. The measured Doppler velocity of 1.75 km/sec was larger than the corresponding value for the thermal velocity. This increase in velocity is apparently due to fine-scale turbulence, since no correlation between increased equivalent line widths and splitting of lines in the magnetic field was evinced.

523.74

18739 THE LIFETIME AND CELL SIZE OF THE GRANULATION IN SUNSPOT UMBRAE.

R.E.Loughhead and R.J.Bray.

Austral. J. Phys., Vol. 13, No. 2, 139-44 (June, 1960).

High-quality photographs extending over a period of 2 hr 11 min were obtained of the granulation in the umbra of a large sunspot. In agreement with earlier work, the mean cell size of the umbral granulation was found to be significantly less, and the lifetime considerably greater, than that of the photospheric granulation. Ten per cent. of the umbral granules last for over 2 hr. The majority of the umbral granules, like the photospheric granules, show no detectable change in brightness, size, or shape during the periods over which they are observed to persist as identifiable structures. Some information is obtained about the modes of formation and dissolution of individual granules. The similarity between the photospheric and umbral granulation is pointed out, and the possible role played by convective processes in sunspots is briefly discussed.

523.74

18740 ON THE INTERPRETATION OF SOLAR GRANULATION. P.Fellgett.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 5, 475-511 (1959).

The technique of interpretation of solar granulation observations is examined with special reference to the stochastic nature of the physical phenomenon, and to the absence in any optical image of sufficient information to allow the intensity distribution in the object to be explicitly inferred. Application is made to the simultaneous velocity and brightness observations of Richardson and Schwarzschild and of Plaskett. It is concluded that the evidence for correlation between velocity and brightness is weaker than has been supposed. Harmonically related periodicities in two sets of the Oxford observations may possibly be connected with magnetohydrodynamic effects, but the suggestion of some authors that there are significant periodicities over large regions of the sun is not confirmed. The investigation has been planned as a contribution towards bringing techniques of interpretation into line with current advances in the observation of granulation, and the programmes developed for carrying out the required calculations on the EDSAC II computer may form a basis for the rapid analysis of future observations.

523.74

18741 NOTE ON THE BRIGHTNESS FLUCTUATION IN THE SOLAR GRANULATION. F.Gaustad and M.Schwarzchild.
Monthly Not. Roy. Astron. Soc., Vol. 121, No. 3, 260-2 (1960).

On photographs of the solar granulation obtained with a balloon-borne telescope, Blackwell, Dewhirst and Dollfus (see Abstr. 16540 of 1960) measured a r.m.s. brightness fluctuation of 4.6%. From this measurement they deduced a true r.m.s. brightness fluctuation of 18%. This deduction was based on an accurate measurement of the contrast transmission function of their instrument, but on an approximate application of this transmission function to the granulation. This note aims to show that, using the same observed r.m.s. brightness fluctuation, the same measured instrumental transmission function, and the same value of 1.4 seconds of arc for the average granule diameter, a more detailed analysis gives a true r.m.s. brightness fluctuation not of 18%, but of only about 7%. The overestimate by Blackwell et al. appears to have resulted from their identifying the granule diameter with a wavelength rather than half a wavelength.

523.74

18742 CENTER-LIMB VARIATION OF THE SLOWLY VARIABLE EARTH MAGNETIC EFFECTIVE SOLAR X-RAY RADIATION AND REMARKS ON THE STRUCTURE OF CORONAL CONDENSATIONS. T.Tamburini and G.Thiessen.
Mem. Soc. Astron. Ital., Vol. 30, No. 3-4, 265-85 (1960).

In order to investigate correlations of daily values of certain phenomena with sunspot numbers it is necessary to account for possible differences between centre-limb variations of the Wolf number of a single spot group and of the additional radiation originating in the surroundings of the same group. This additional radiation will be responsible for the phenomena to be correlated with the sunspot numbers. A maximum correlation coefficient results if the sunspot number for the whole disk is calculated with the same centre-limb variation as is valid for the additional radiation. The centre-limb variation of the slowly varying X-ray radiation of about 40-100 A is determined by means of the maximum correlation coefficient of the daily values of the daily amplitude of the horizontal intensity of the earth magnetic field at Huancayo with the daily sunspot numbers. It is very strong: at a distance of 26° and 45° from the centre of the solar disk the intensity has dropped to about 1/2 and 1/20 respectively of the central value. Very probably the coronal condensations are regions with higher densities but lower temperatures as compared to the neighbouring general corona.

523.74 : 551.5

A MONTHLY IONOSPHERIC INDEX OF SOLAR ACTIVITY BASED ON F2-LAYER IONIZATION AT ELEVEN STATIONS. See Abstr. 18500

523.75

18743 PHENOMENA OF THE SOLAR ATMOSPHERE. R.G.Athay.
Science, Vol. 132, 707-11 (Sept. 16, 1960).

Survey article.

523.75

18744 A STUDY OF THE DETERMINATION OF SOLAR ATMOSPHERIC ABUNDANCES. D.Mugglestone.
Monthly Not. Roy. Astron. Soc., Vol. 118, No. 5, 432-57 (1958).

523.75

18745 THE EFFECT OF BLANKETING ON THE STRUCTURE OF THE SOLAR ATMOSPHERE. A.Przybylski.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 5, 483-92 (1957).

523.75

18746 A COMPARISON OF SOLAR ATMOSPHERIC MODELS BY STARK EFFECT IN H-GAMMA: NITROGEN ABUNDANCE. D.Mugglestone.
Monthly Not. Roy. Astron. Soc., Vol. 120, No. 3, 193-200 (1960).

Three solar atmospheric models are considered, i.e., the models of Claas, Vitense and Swihart. The criterion of reliability adopted here is that the models should correctly predict the observed intensities in the far wing of the H-gamma absorption line. An improved theory of Stark broadening is used, due to Kolb, where the ions are treated according to the usual Holtsmark statistical theory and also the effect of the electrons, and their finite velocities is included. It is found that the electronic and ionic contributions to the absorption coefficient are of the same order of magnitude, in the far wing, and therefore the electronic effect should not be neglec
Results indicate that, of the models considered, the Swihart mod
is to be preferred. In a previous paper the nitrogen abundance i
the solar atmosphere was determined, using each of the above models, by a method dependent only upon the physical characteristics of the chosen atmospheric model. Placing now additional weight on the results obtained using the Swihart model, the most probable value of the nitrogen abundance is found to be log A_N = 7
(on the basis log A_H = 12.00).

523.5

18747 NOTE ON COLLISIONAL DISSOCIATION OF THE H^- ION IN THE SOLAR ATMOSPHERE. B.E.J.Page
Monthly Not. Roy. Astron. Soc., Vol. 119, No. 6, 609-11 (1959).

New data on collisional dissociation of H^- ions suggest that electron impact is a negligible factor, but that associative electr
detachment by impacts with neutral hydrogen atoms is powerful enough to maintain an H^- : H ratio in accordance with local ther
dynamic equilibrium in the photospheric layers.

52

18748 TEMPERATURES REACHED IN ELECTRICAL DISCHARGES IN THE SOLAR ATMOSPHERE C.E.R.Br
Nature (London), Vol. 187, 865-6 (Sept. 3, 1960).

The author's generalized electrical discharge theory of cosmical and astrophysical phenomena (1944), when applied to explain the main features of geomagnetic storms and aurorae, pred
"discharge" temperatures of ~10^8 °K in the interplanetary solar atmosphere. Recently, rocket measurements made at great heig
above the earth, have confirmed the reality of such ultra-high temperatures. Similar temperatures are found also in galactic electrical discharges, and in the later evolutionary changes of the combination-spectra stars, e.g. Z Andromedae. It is pointed out that the very high temperature of the interplanetary gas is alway
associated with the outward propagation of a solar electrical discharge channel, or "jet", with a velocity equal to that of sound at
temperature of the gas stream. On this view, the upper limit of t
discharge temperature will be that at which thermonuclear reacti
set in, i.e. ~4 × 10^8 °K. D.R.Barb

523.

18749 THE IRREGULAR STRUCTURE OF THE SOLAR CORONA DURING 1959 JUNE.
S.Gorgolewski and A.Hewish.
Observatory, Vol. 80, 99-103 (June, 1960).

Observations of the scattering of radiowaves from the Crab Nebula on passage through the solar corona show the scattering to be anisotropic. This indicates a filamentary nature for the scattering centres and the observations suggest that these extend to at least 30-40 solar radii. Within 10 solar radii refraction effects may be important. C.Haza

523.

18750 THE SLOW EVOLUTION OF CORONAL JETS. M.Trellis.
Ann. Astrophys.,Vol. 22, No. 6, 845-54 (1959). In French.

Isophote maps of the corona plotted from observations made
the green coronal line show that the lifetime of a "coronal jet" is proportional to its maximum intensity and permit one to plot the light curve of its slowly variable component. From this the numb
of "coronal jets" having reached a given intensity may be calculat
for different phases of the eleven-year cycle, giving a sensitive index of solar activity.

523.

18751 A NOTE ON THE CALCULATION OF CORONAL IONIZATION CROSS-SECTIONS. A.Burgess.
Astrophys. J., Vol. 132, No. 2, 503-5 (Sept., 1960).

Examples are given of the method used to compute ionization cross-sections for hydrogen-like positive ions e.g. He$^+$. It is sho
that the recently published data of Schwartz and Zirin (1959) for Fe XIV yields cross-sections that are certainly much too small. These values should not be used, therefore, when calculating electron temperatures in the solar corona. D.R.Barb

523.

18752 THE STRUCTURE OF THE NON-UNIFORMITIES OF THE SOLAR SUPERCORONA.
V.V.Vitkevich and B.N.Panovkin.
Astron. Zh., Vol. 36, No. 3, 544-6 (1959). In Russian. English

lation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3,
30 (Dec., 1959).
Observations of the occultation of the Crab nebula by the solar
a, made in July 1957, showed that the non-uniformities of the
corona have the form of elongated streams, the directions of
are mainly radial or nearly radial. Such an orientation of
on-uniformities does not contradict the general idea that the
uniformities of the supercorona are oriented along the lines
rce of the general solar magnetic field, considered as a dipole.

523.75

8753 THE STRUCTURE OF THE OUTERMOST CORONA [SUPERCORONA] OF JUNE 19, 1936. V.A.Bronshtén.

on. Zh., Vol. 36, No. 5, 845-50 (1959). In Russian. English
slation in: Soviet Astron.—AJ (New York), Vol. 3, No. 5, 821-6
ch-April, 1960).
The structure of the outermost corona (at a distance of more
one solar diameter from the moon's limb) was studied using
graphs obtained during the solar eclipse of June 19, 1936.

523.75

754 THE SOLAR SUPERCORONA FROM THE OBSERVATIONS OF 1951-1958. V.V.Vitkevich.

on. Zh., Vol. 37, No. 1, 32-41 (1960). In Russian. English
slation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1,
(July-Aug., 1960).
Radio observations of the solar supercorona, made at the
ean station of the Institute of Physics, U.S.S.R. are summarized.
e observations were made on different wavelengths and with
rent interferometer base lines. The average properties of the
rcorona at the minimum phase of solar activity have been
. During the period of maximum solar activity, the electron
ity of coronal irregularities increases, on the average, by a
r of 2. An increase of the electron density is observed for the
, as well as for the inner, regions of the supercorona. The
r limit of the velocity of the plasma ejected from the sun
g the period of maximum solar activity, and reaching the outer
ons of the supercorona, is 1 km/sec.

523.75

8755 INTENSITIES, POLARIZATION AND ELECTRON DENSITY OF THE SOLAR CORONA FROM PHOTO-PHS TAKEN AT THE SOLAR ECLIPSE OF 1952, FEBRUARY 25.

n Klüber.
hly Not. Roy. Astron. Soc., Vol. 118, No. 3, 201-23 (1958).

523.75

756 OBSERVATIONS OF PROMINENCES AND THE HEIGHT OF THE SOLAR CHROMOSPHERE CARRIED OUT IN

. G.Noci and M.Rigutti.
. Soc. Astron. Ital., Vol. 31, No. 1, 33-8 (1960). In Italian.
The observations carried out in 1958, in accordance with the
ramme of work at Acetri Observatory, are given. The results
compared with those of the preceding years.

523.75

8757 APPARENT SOLAR PROMINENCES CAUSED BY JET PLANES CROSSING THE SOLAR LIMB.

Feibelman.
rvatory, Vol. 80, 152-3 (Aug., 1960).
Examples of the spurious "solar prominences" first described
hman [(Observatory Vol. 79, 217 (Dec., 1959)] are cited and
trated. In one instance, when the "surge" was produced by a
ghter aircraft diving and banking in front of the sun, both
ss and egress "surges" were photographed. D.R.Barber

523.75

758 AN ELECTROMAGNETIC MECHANISM OF HEATING SOLAR PROMINENCES. S.O.Obashev.

on. Zh., Vol. 36, No. 6, 1037-40 (1959). In Russian. English
slation in: Soviet Astron.—AJ (New York), Vol. 3, No. 6, 951-4
-June, 1960).
It is shown that the division of prominences into quiescent and
tive ones results from the presence of magnetic fields of dif-
nt strengths. The magnetic-field strength of eruptive promi-
es is greater than that of quiescent prominences. A formula
he lifetime of a prominence is derived. The lifetime is pro-
ional to prominence size, and decreases with increasing field
ngth. The field strength of a prominence is estimated from its
ime; this estimate agrees with that obtained from the motion
e prominence.

523.75

18759 MEASUREMENT OF MAGNETIC FIELDS IN CHROMOSPHERIC FLARES.

M.Blaha, M.Kopecký and Z.Švestka.
Nature (London), Vol. 187, 224-5 (July 16, 1960).

Zeeman-splitting of the D_1 (Na I) line, but not of the D_2 component, was found in the spectra of two intense flares. Splitting of the 3706 A line of Ca II was also observed. Both flares occurred centrally on the solar disk, and directly over active sunspot zones. It was thus possible to deduce the magnetic-field intensity from measures of the σ component of the Zeeman pattern only. Both flares were photographed above a sunspot with a large magnetic field; and the values of field intensity, deduced from the Zeeman effect, and from the spot-field are in good agreement: 3000-4000 G.

D.R.Barber

523.75 : 551.5 : 550.3

18760 CHROMOSPHERIC FLARES ASSOCIATED WITH TYPE IV RADIO BURSTS. IONOSPHERIC AND GEOMAGNETIC EFFECTS. P.Simon.

Ann. Astrophys., Vol. 23, No. 1, 102-10 (1960). In French.

The flares associated with type IV radio bursts are intimately related to the PIDB, the most important of these flares giving rise to particularly severe geomagnetic perturbations.

523.75

18761 Hβ, Hγ AND K PROFILES IN CHROMOSPHERIC SPICULES. R.G.Athay.

Ann. Astrophys., Vol. 23, No. 2, 250-61 (1960).

The study of line profiles for chromospheric spicules is extended to the Hβ, Hγ and K-lines. Earlier observations of the D_3 line in conjunction with the Hβ and Hγ lines indicates a kinetic temperature of about 50 000°. The K-line is found to have anomalous broadening from a non-thermal velocity field not shared by hydrogen and He I. This velocity field of the Ca II ions is tentatively identified as the interaction of Ca II ions with magnetic fields.

523.75

18762 SOLAR SPICULES AND HEATING OF SOLAR OUTER ATMOSPHERE. T.Watanabe.

Rep. Ionosphere Res. Japan, Vol. 12, No. 2, 160-8 (June, 1958).

The solar spicule is a shock wave driven by the piston-like action of the granular motion and confined in a tube with an "elastic wall" consisting of the lines of force of the solar general magnetic field. The temperature is higher and the density is larger in the spicular region than in the interspicular region. The increased internal energy of the spicular matter flows outwards through radiation, which heats the lower chromosphere. The polar rays and coronal streamers are conjectured to be shock waves driven by photospheric turbulence of which the scale and life-time are far larger than those of granules. It appears that the corona is heated by polar rays and coronal streamers and by convection from the lower atmosphere. Another suggestion is made that spicules, polar rays and coronal streamers are seats of pinched electric discharges, which heat up the solar outer atmosphere.

523.75

18763 ON THE ORIGIN OF SOLAR FLARES.

T.Gold and F.Hoyle.
Monthly Not. Roy. Astron. Soc., Vol. 120, No. 2, 89-105 (1960).

Two major problems in the interpretation of solar flares are discussed: firstly, by what means high concentrations of energy can be stored in the chromosphere; and secondly, what process can account for the suddenness with which this energy is released during a flare? It is shown that the energy storage can be accounted for only by a particular class of magnetic fields whose lines of force have the general shape of twisted loops protruding above the photosphere. In active regions with strong magnetic fields it is likely that chromospheric motions are entirely dictated by the flow of the much more massive photospheric material. Forces arising from pressure, weight or acceleration of chromospheric gas are most of the time small, so that the motions there are closely those that retain at each moment a force-free field compatible with the magnetic boundary conditions at the photosphere and, as the chromosphere is a good conductor, with the past history of the motion. A sudden release of energy in such a system can result only in a case where the magnetic forces act so as to drive the system away from the force-free configuration, and the energy associated with chromospheric currents can then be dissipated into motion or heat. This will occur when twisted magnetic loops of opposite sense and opposite twist meet. Such loops attract each other, and the annihilation of the longitudinal component of the field where they meet leads to a sudden constriction of the current and through this to a dissipation of the energy associated with that current.

523.75 : 550.3

ON THE GREAT SOLAR FLARE WHICH STARTED AT 21 h 09 m, FEBRUARY 9TH, 1958, AS THE LIKELY SOURCE OF GEOMAGNETIC STORM, FEBRUARY 11TH. See Abstr. 18472

523.75

18764 **THE SOLAR FLARE OF JUNE 1, 1960.**
M.A.Ellison, S.M.P.McKenna and J.H.Reid.
Nature (London), Vol. 187, 926 (Sept. 10, 1960).

A summary of the main characteristics, and associated geophysical effects of the exceptionally extensive Class 3^+ flare of June 1, 1960. The Lyot Hα heliograph at the Royal Observatory, Cape of Good Hope, was used to obtain a complete record of the flare at 1 min intervals with a cloudless sky. D.R.Barber

523.75

18765 **THE SOLAR FLARE OF 1960 APRIL 1.**
M.A.Ellison, S.M.P.McKenna and J.H.Reid.
Observatory, Vol. 80, 149-52 (Aug., 1960).

An unusual feature of this Class-3 flare was an expanding "halo" region, surrounding the emission filaments, that commenced to develop shortly after maximum flare intensity had been reached. The feature persisted for about 3½ hr. Two possible explanations of the "halo" phenomenon are discussed. D.R.Barber

523.76

18766 **DIFFUSION IN THE SUN.**
L.H.Aller and S.Chapman.
Astrophys. J., Vol. 132, No. 2, 461-72 (Sept., 1960).

The gradients of pressure and temperature in the sun set up an electrostatic field that maintains electrical neutrality to a high degree of approximation. The gradients and the field cause the heavier ions to diffuse downward. The rate of this diffusion is estimated for different depths, on the basis of a model obtained by Weymann. The diffusive drainage of the heavier elements from the convection zone reduces their abundances relative to hydrogen in the sun's atmosphere. It also affects their relative abundances among themselves. The reduction is naturally greater, the shallower the convection region. The low abundance of lithium in the sun's atmosphere is taken to indicate that the convective region extends to a depth at which its destruction by nuclear reactions can occur — namely, down to three-tenths of the solar radius. For this depth the reduction of the abundance of the heavier elements brought about by diffusion during 4.5×10^9 years is about 10% for silicon, 12% for iron, and about 25% for lead. The diffusion will modify the concentration of these elements in the region below, but only by a small percentage.

523.76

18767 **ON A POSSIBLE MECHANISM OF SOLAR NON-STABLE PROCESSES LEADING TO NEUTRON ERUPTIONS.**
V.A.Petukhov.
Ann. Geophys., Vol. 14, No. 4, 425-32 (1958).

The neutron hypothesis leads to a reasonable explanation for the direction of the corpuscular flux ejected from the active regions of the sun. The question of the possibility of a generation on the sun of neutrons is the consequence of a wider class of phenomena connected with general solar non-stability. It is shown that the formation in the internal parts of the sun in the process of its evolution of a nucleus with increased lithium concentration may be the initial cause of non-stable processes of all kinds and, in particular, the formation of sunspots. Free neutron decay will make it possible to account for the presence of hard X-rays in the composition of solar radiation. As it follows from the considered mechanism of intersolar mass ejection the axis of the corpuscular flux may not coincide with the radial direction as a result of which the corpuscular velocities calculated usually by the lag of terrestrial phenomena are low and must be reconsidered.

523.77

18768 **SPECTROSCOPY OF SOLAR ERUPTIONS IN THE FRENCH PROGRAMME FOR THE I.G.Y. I. INSTRUMENTS AND OBSERVATIONS.**
R.Michard, R.Servajean and G.Laborde.
Ann. Astrophys., Vol. 22, No. 6, 877-86 (1959). In French.

For the I.G.Y., a laboratory devoted to the spectroscopic stu of flares and associated phenomena was installed at the Pic du Mi Observatory. The main instrument is a spectrograph that can pho graph in a single exposure the whole solar spectrum from λ 3550 to about 9000 A, with a mean dispersion of 2 A mm^{-1}. A Lyot type H_α filter is used to detect flares and bring them on the slit. Auxiliary arrangements include H_α photography of the flare unde study, and possibility of fast cinematography of the H_α spectra o an extended solar region.

523.7

18769 **SPECTROSCOPY OF SOLAR ERUPTIONS IN THE FRENCH PROGRAMME FOR THE I.G.Y. II. GENERALITIES ON THE SPECTRA OF THE ERUPTIONS.** R.Michard
Ann. Astrophys., Vol. 22, No. 6, 887-900 (1959). In French.

Some 200 spectra (λ 8800-3600) of 60 different flares have be examined qualitatively; estimates have been made of the intensiti of important lines and of the continuum when present. Spectral variations with phase and with location on the disk of the flare ph nomena were found statistically. The emission of metallic lines comes from deeper layers than hydrogen line emission, and decreases generally faster after the maximum. The continuum is confined to the earlier phase of the flare; its spectral distributio ("violet" colour) and centre-limb variation are similar to those o faculae. The observations suggest that flares seen outside the li generally pertain to a later phase in the flare process than the "flash" of disk flares; their emission comes from higher layers a has different characteristics.

523.7

18770 **THE SOLAR EMISSION INTENSITY AT 11μ**
F.Saiedy and R.M.Goody.
Monthly Not. Roy. Astron. Soc., Vol. 119, No. 3, 213-22 (1959).

Observations were made during spring 1958 of the central emission intensity of the Sun at a wave-length of 11.10μ (901 cm^{-1} by direct comparison with the emission of a black body at 1300° K. The solar intensity was reduced to approximately that of the black body by the use of rotating sector disks, and the ratio of intensitie was then measured by a calibrated electrical attenuator so that th system was independent of the detector linearity. The only subsidiary measurements needed were the absolute reflectivity of one mirror and the variation of reflectivity with angle of reflection of another. The slit width of 0.031μ or 2.5 cm^{-1} was small enough to enter an atmospheric "window" where the terrestrial absorption obeys Lambert's law, thereby allowing extrapolation to extraterrestrial intensity. The weighted mean of five measurements of the central intensity was (at 11.10μ) equal to $2.408 \pm 0.016 \times 10^{10}$ erg cm^{-2} ster^{-1} sec^{-1} (per cm wave-length range). This is equivalent to a central temperature (at 11.10μ) of 5036 ± 30° K.

523.

18771 **THE SPECTROSCOPY OF SOLAR FLARES WITH ECHELETTE GRATINGS.**
A.B.Severnyi, N.V.Steshenko and V.L.Khokhlova.
Astron. Zh., Vol. 37, No. 1, 23-31 (1960). In Russian. English translation in: Soviet Astron.–AJ (New York), Vol. 4, No. 1, 19-30 (July-Aug., 1960).

An attempt is described to apply an echelette grating to the spectroscopy of solar flares and other nonstationary processes on the sun with the aid of a solar tower telescope. The optical schem of the spectrograph is given. The echelette allows the solar spectrum in the range 3700-6600 A to be obtained in the form of adjace strips covering a 13 × 18 cm plate. The dispersion is ≅1 A/mm, the resolving power ≅0.04 A, and the exposure $0^s.5$. Examples of the spectra of the sun and solar flares are given. With this echele it is possible to detect a large number of emission lines in flare spectra. The hydrogen lines in individual cases can be seen as fa as H_{22}, about 12 lines of He (including 4686 A He II) can be detecte and more than 450 metallic and other lines can be identified in fla spectra. A catalogue is given of emission lines in the spectrum of the flare of 17 August 1959, obtained with the echelette grating.

523.

18772 **A COMPARISON OF THE GROWTH CURVES FOR THE CENTRE AND THE LIMB OF THE SOLAR DISK.**
R.B.Teplitskaya.
Astron. Zh., Vol. 37, No. 1, 51-62 (1960). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, 49-5 (July-Aug., 1960).

The variation of the equivalent widths of Fe I and Ti I towards olar limb is studied by means of the growth curves. The retical growth curves for the solar centre and the limb were puted using two models of the photosphere: Vitense II and Voigt, de Jager VII. It was found that the former model is in better ement with observations. A small increase in the turbulence city toward the outer layers of the solar atmosphere was cted. The existence of the parity effect in the broadening of tral lines is confirmed.

523.77

3773 PROBLEMS IN THE DETERMINATION OF CONTOURS OF SOLAR LINES NEAR THE EXTREME LIMB.

Hart.

hly Not. Roy. Astron. Soc., Vol. 120, No. 2, 106-20 (1960).

In the first part of the paper the distorting effects of the earth's sphere on the distribution of light at the extreme limb of the are considered. An analytical expression is found which ribes the resultant redistribution of light in the focal plane of elescope; the effects of "seeing" are represented by a Gaussian , particle scattering and non-specular reflection by the tele- e optics are included in a power-law term. This redistribution tion forms the kernel of the integral equation relating the true bserved intensities at any point. A geometrical idealization ces the two-dimensional equation to an equation in one dimen- Methods of solving this equation which do not presuppose an ytical form of the true distribution are investigated and it is n that the solutions must be regarded as discontinuous. In r to apply these methods, observations of the K line of Ca II made at points within ± 10" arc of the limb, on two days. The vant parameters in the redistribution function were determined the observations. A numerical application of the solution of ntegral equation then gave the true line profiles. The accuracy nable in the solution is shown to depend rather strongly on the of the kernel and hence on the atmospheric conditions.

523.77

3774 A NEW DETERMINATION OF THE CENTRE TO LIMB CHANGE IN SOLAR WAVE-LENGTHS. M.G.Adam.

thly Not. Roy. Astron. Soc., Vol. 119, No. 5, 460-74 (1959).

The centre-to-limb increase in wavelength, which is observed nedium strength solar lines, occurs almost wholly over the last of the way across the disk. So far, measurements have not been e in this region with nearly high enough disk resolution. The rd 35 m telescope, which gives a solar image of radius 165 mm, sed to make detailed observations of limb effect for 261 disk ts in latitudes near to the solar equator. The observed points e close to the limb, at radial distances from the centre between nd 100% of the disk radius. The individual observations show iderable fluctuations about a mean curve, which are attributed e local velocity fields which are known to exist on the sun. The ematic differences which appear in the measures from the east and the west limb, for radial distances greater than 98% of the radius, are shown to be the result of light scattering. In the rvational determination of the limb-effect curve it is most im- ant that distortions, due to velocity fields and scattered light, ld be taken into account. The new limb-effect curve is in fair ement with the old determinations, over the range in common. e extreme limb there is a shift with respect to the centre wave- ths which, expressed as a Doppler velocity, amounts to km sec^{-1}. This indicates at the extreme limb a red shift of km sec^{-1} compared with the Einstein shift of 0.636 km sec^{-1}.

523.77 : 539.19

3775 EXCITATION TEMPERATURES FOR THE CN EMISSION FROM THE LOW CHROMOSPHERE.

.Thomas.

thly Not. Roy. Astron. Soc., Vol. 118, No. 5, 458-76 (1958).

523.77

8776 THE CORONAL EMISSION LINE λ 5694..

G.M.Nikol'skii.

on. Zh., Vol. 36, No. 3, 477-80 (1959). In Russian. English slation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3, 9 (Dec., 1959).

Analysis of published non-eclipse observations of the corona in 94 and λ 6374 confirms Elwert's theory (1958) which explains emission of these lines in the same coronal region as being due to the ionizing action of the hard radiation of coronal condensations on Ca XI ions in the "red regions" of the corona. The fact that the latter possibility is realized, imposes additional limitations on the choice of the ion giving rise to the λ 5694 line. Apparently, Edlen's identification of the yellow line with Ca XV (1942) is correct.

523.77

18777 THE IDENTIFICATION OF CORONAL LINES.

L.A.Borisoglebskii.

Astron. Zh., Vol. 36, No. 5, 905-7 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 5, 879-80 (March-April, 1960).

Discusses the identification of Ca XV coronal lines. Reports a recalculation of the ratio of intensities of the Ca XV lines λ 5694.4 and λ 5446.5 A using recent theoretical data on transition probabilities and the parameters Ω (i, k).

523.77

18778 ON THE RED SHIFT OF THE SOLAR LINES. III.

E.Finlay-Freundlich and E.G.Forbes.

Ann. Astrophys., Vol. 22, No. 6, 727-32 (1959).

For earlier parts, see Abstr. 4999 of 1957; 2106 of 1958. The new interpretation of the red shift first suggested by one of the authors from a study of stellar spectra (1954) is shown to account completely, without any remainder, for the only set of absolute (sun-arc) wavelength displacements presently available, i.e. interferometric measurements made by M.G.Adam at Oxford (1948) — and for the extensive relative (limb-centre) differences observed by W.Adams at Mt. Wilson (1910). The existence of this unestablished physical effect leaves no room for the constant red shift predicted by the General Theory of Relativity.

523.77

18779 CONTINUOUS SOLAR EMISSION IN THE X-RAY REGION.

T.V.Kazachevskaya and G.S.Ivanov-Kholodnyi.

Astron. Zh., Vol. 36, No. 6, 1022-7 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 6, 937-42 (May-June, 1960).

The Gaunt-factor and the continuous emission spectrum of the solar corona were calculated. $T \cong 1.5 \times 10^6$ °K was found from X-ray emission data and also from the intensity ratio of X-ray and radio emission. At the earth's surface, the energy of solar continuous emission beyond the Lyman limit is >0.3 ergs cm^{-2} sec^{-1}. It is shown that the solar corona is extremely nonuniform; the matter in it is mainly concentrated in regions which occupy only 0.01 of the total volume.

523.78

18780 THE SOLAR ECLIPSE OF 15 FEBRUARY, 1961.

A.A.Mikhailov.

Astron. Zh., Vol. 37, No. 1, 67-74 (1960). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, 64-73 (July-Aug., 1960).

Detailed data are given for the track of the total eclipse, from the Balkan peninsula to the eastern point where the eclipse occurs on the horizon. The argument is Moscow Standard Time, which is 3 hours ahead of Universal Time. The longitudes are reckoned from the Greenwich meridian eastwards. The differential coefficients A, B, φ, Λ are used for obtaining data for the total eclipse at points situated within the zone of totality.

523.78 : 550.3

EFFECT OF THE SOLAR ECLIPSE ON APRIL 19, 1958 ON THE GEOMAGNETIC FIELD. See Abstr. 18471-2

523.6

18781 SYMPOSIUM: SUBDWARF STARS.

Edited by M.Schwarzschild.

Astron. J., Vol. 65, No. 7, 391-403 (Sept., 1960).

On hundred-fifth meeting of the American Astronomical Society, Pittsburgh, April, 1960. Five papers were read, each one being followed by a discussion. The titles of the papers are listed in the following abstracts.

523.8

18782 TRIGONOMETRIC PARALLAXES OF SUBDWARFS.

P.van de Kamp.

Astron. J., Vol. 65, No. 7, 391-2 (Sept., 1960).

523.8

18783 SPACE MOTIONS OF THE SUBDWARFS. O.J Eggen.
Astron. J., Vol. 65, No. 7, 393-5 (Sept., 1960).

523.8

18784 INTERIOR MODELS FOR SUBDWARF STARS. P.Demarque.
Astron. J., Vol. 65, No. 7, 396-8 (Sept., 1960).

523.8

18785 COMPOSITIONS AND MEAN ATMOSPHERIC PARAMETERS OF SUBDWARFS. L.H.Aller.
Astron. J., Vol. 65, No. 7, 399-402 (Sept., 1960).

523.8

18786 A SERIES OF SUBDWARF ATMOSPHERES. T.L.Swihart.
Astron. J., Vol. 65, No. 7, 403 (Sept., 1960).

523.8

18787 PERTURBATIONS OF STELLAR VELOCITIES. II. CALCULATION OF MOMENTS OF ORDER GREATER THAN 2. M.Hénon.
Ann. Astrophys., Vol. 23, No. 3, 467-73 (1960). In French.

For previous part, see Abstr. 4902 of 1960. Under certain conditions, the probability is calculated for a given velocity perturbation of a test star in motion in a field of stars. The general formula for the moments of order greater than 2 is derived.

523.8

18788 ASTROMETRIC ANALYSIS OF LALANDE 21185. S.L.Lippincott.
Astron. J., Vol. 65, No. 7, 445-8 (Sept., 1960).

The variable proper motion of Lalande 21185 was discovered in 1941 from plates taken with the 24 in. Sproul telescope. Measurements and reductions of the plates over the interval 1912-1959 yield $+0''.399 \pm 0''.002$ for the relative parallax and indicate a period of $8^y.0 \pm 0^y.3$ with $0''.0336 \pm 0''.0024$ for the value of the semi-axis major of the photocentric orbit. Assuming a mass for the primary, appropriate for a dM2 star, a mass of the order of 0.01 ⊙ is found for the unseen companion.

523.8 : 539.12

18789 NET ELECTRIC CHARGES ON STARS, GALAXIES AND "NEUTRAL" ELEMENTARY PARTICLES. V.A.Bailey.
J. Roy. Soc. New S.Wales, Vol. 94, Pt 2, 77-86 (1960).

The orthodox assumption in astronomy that stars cannot carry appreciable net electric charges is abandoned and as a result of the contrary assumption it has been found possible to account for the known orders of magnitude of five different astronomical phenomena and the directions relating to three of them, as well as to explain qualitatively or semi-quantitatively at least thirteen other phenomena. The first five are: (1) the maximum energy of about 5×10^{18} eV found for a primary cosmic ray particle; (2) the sun's polar magnetic field vectors; (3) the approximate equality for the sun and for Blackett's average of five magnetic stars, of P/U the ratio of the magnetic moment to the angular momentum of the star concerned; (4) the present state of magnetization of the earth; (5) the existence and position of the outer Van Allen belt. To provide a source for the charge on a star two alternative hypotheses are advanced.

523.82

18790 EFFECT OF INTERSTELLAR ABSORPTION ON THE HETEROCHROMATIC MAGNITUDES. QUALITATIVE INTERPRETATION. R.Canavaggia.
Ann. Astrophys., Vol. 22, No. 6, 765-8 (1959). In French.

As is well known, a heterochromatic magnitude differs from the monochromatic magnitude relative to the Strömgren—Wesselink wavelength by a term of second order, due to the curvature of the incident radiation spectrum. The result is that, by the effect of interstellar absorption on a heterochromatic magnitude, two effects can be distinguished: the main effect, that of monochromatic absorption on the Strömgren—Wessenlink wave length; and a secondary effect, due to the absorption modifying the curvature of the initial radiation spectrum. The curvature effect is analysed for two kinds of initial radiation: a black body at 25 000° and a yellow giant of effective temperature 5930°. For the very large reddenings, the secondary effect always acts contrariwise to the absorption itself, so that the heterochromatic magnitude appears to resist the absorption. When considering such reddenings, the "effective frequency" of Whitford ceases to be preferable.

52.82

18791 ABSORPTION OF LIGHT IN A REGION IN THE RIFT OF THE MILKY WAY [AQUILA CONSTELLATION]. T.A.Uranova.
Astron. Zh., Vol. 36, No. 4, 740-3 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 4, 718-20 (Jan.-Feb., 1960).

Preliminary results are given which were obtained from a study of the photoelectric colours and the density of the apparent distribution of stars with known distance moduli. A schematic representation of the structure of the dark nebula which occupies the investigated region of the sky is given.

52.82

18792 COLOR EXCESSES FOR SUPERGIANTS AND CLASSICAL CEPHEIDS. I. CALIBRATION OF THE G-BAND PHOTOMETRY. R.P.Kraft.
Astrophys. J., Vol. 131, No. 2, 330-50 (March, 1960).

52.32

18793 COLOR EXCESSES FOR SUPERGIANTS AND CLASSI CAL CEPHEIDS. II. THE PERIOD—COLOUR RELAT FOR CLASSICAL CEPHEIDS. R.P.Kraft.
Astrophys. J., Vol. 132, No. 2, 404-16 (Sept., 1960).

For Pt I, see Astrophys. J., Vol. 131, No. 2, 330 (March, 196 The correlation between spectral type and intrinsic color for F a G supergiants of class Ib that was set up in Pt I is improved slig and colour excesses of precision (m.e.) ± 0.03 mag. (B—V) are given for 32 classical cepheids. The relation between period and mean colour is found to be surprisingly close, especially for ceph of large amplitude. At a given period, the amplitude of the blue (or visual) light-curve is evidently correlated with the deviation o a cepheid from the period-mean-colour relation. A quantity f_B is defined which gives the amplitude of the blue light-curve of a cepheid in terms of the maximum amplitude that has been observ for that period (in the vicinity of the sun). Equations are given fo calculating a colour excess E(B—V) from the period, the observe mean colour, and f_B. It is suggested that f_B (or some equivalent quantity) be used in place of the notation A, B, C. The estimation excesses from a relation between period and colour at maximum light is not recommended. The colour excess of β Dor, which is near the Large Magellanic Cloud, is briefly discussed.

523.

18794 CHROMATIC SCINTILLATIONS. L.N.Zhukova.
Astron. Zh., Vol. 36, No. 3, 548-9 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3, 533-4 (Dec., 1959).

In order to study the chromatic scintillations of stars, their spectral trails were photographed. Photometric measurements w made in the region λ 5800-3800 A. It was found that for z ≥ 75°, n correlation is observed between the variations of brightness in different spectral regions for Δλ 200-1000 A.

523.8

18795 AN EMPIRICAL FORMULA FOR THE CHARACTERISTIC CURVE OF STELLAR FOCAL IMAGES. V.S.Matyagin.
Astron. Zh., Vol. 36, No. 5, 909-12 (1959). In Russian. English translation in Soviet Astron.—AJ (New York), Vol. 3, No. 5, 883-6 (March-April, 1960).

An empirical formula representing the characteristic curve in focal stellar photometry is proposed. The formula may be use to represent the characteristic curve of a negative when the background (sky fog) around the stellar images is of varying density. It can therefore be used to construct stellar magnitude scales on different colour systems, when applying the method of reduced stellar brightness which simultaneously reduces also the density of the sky fog.

523.82 : 530.

18796 THEORY OF RADIATION DIFFUSION IN STELLAR ATMOSPHERES. V.V.Sobolev.
Astron. Zh., Vol. 36, No. 4, 573-8 (1959). In Russian. English

lation in: Soviet Astron.—AJ (New York), Vol. 3, No. 4, 563-8
-Feb., 1960).
The integral equation with a kernel depending on the absolute
of the difference of two quantities is investigated. The
ion of this equation (both homogeneous and inhomogeneous) is
according to the method proposed previously by the author
3). As an example, the integral equations of radiation diffusion
onsidered.

523.82

3797 ABSOLUTE MEASURES OF STELLAR RADIATION.

R.V.Willstrop.

thly Not. Roy. Astron. Soc., Vol. 121, No. 1, 17-40 (1960).
Observations at the Cambridge Observatories showed that the
d-band V and B photometric systems may be reproduced by
rvations in narrow bands about 200 A broad centred at 5410 A
at 4390 A respectively. At the Royal Observatory, Cape of Good
e, measurements were made of the radiation flux outside the
h's atmosphere in four narrow (~200 A) wavelength bands from
s of known magnitude and colour index, by comparing bright
s with an artificial star, composed of a calibrated lamp and blue
r. A 4 in. refractor was used, with interference filters and a
photometer. The results are in good agreement with some other
nt measurements. Systematic errors are discussed in detail.
row-band visual magnitudes were measured for 221 stars, and
pared with broad-band magnitudes determined by Johnson, by
and by Eggen, and with early and recent Cape results. When
ar colour equations are removed the standard deviations of the
duals are between $\pm 0^{m}.014$ and $\pm 0^{m}.036$. The internal random
rs of the best individual series are believed to be $\pm 0^{m}.010$
row-band) $\pm 0^{m}.007$ (Johnson) and $\pm 0^{m}.007$ (Cape). It follows that
large differences usually found between similar broad-band
al magnitudes cannot be explained by differences of band-width
equivalent wave-length combined with differences of stellar
tra. There is good agreement between the present narrow-band
ur indices and gradients on the Greenwich system measured at
tromlo. The relation between absolute and Greenwich gradients
found to be $\phi = G_G + 1.11$, in excellent agreement with the best
ious results.

523.84

8798 THE COOLING OF THE [STELLAR] ATMOSPHERE BEHIND THE SHOCK-WAVE FRONT [IN PULSATING RS].

J.Kubikowski.

. Astrophys., Vol. 22, No. 6, 741-7 (1959). In French.
The rate of cooling of the stellar atmosphere, after shock-wave
ing, has been calculated. Having introduced the jump of tempera-
into the isothermic model of atmosphere of Vir it was found
the temperature just behind the shock front is about 30 000°.
interval of time in which this temperature is reduced by the
r of 2 is 180 s, and the optical thickness of the corresponding
r is 0.07. It is concluded that: (1) The isothermic approxi-
ion is not justified even in the exterior layers of the atmosphere.
The influence of the shock wave on the spectral lines can be
ificant.

523.84

8799 CALCULATION OF THE ORBITS OF DOUBLE STARS. I.

A.Kranjc.

. Soc. Astron. Ital., Vol. 31, No. 1, 61-74 (1960). In Italian.
A suitable form of the descriptive equations is derived for the
truction of a programme for an IBM 650 computer. The results
seven double star systems are tabulated.

523.84

8800 ON THE POTENTIALS OF THE FREE SURFACES OF CLOSE BINARY SYSTEMS: (A CRITICAL SUPPLE- T TO THE WORK OF Z.KOPAL: THE CLASSIFICATION OF SE BINARY SYSTEMS).

K.Walter.

. Astrophys., Vol. 22, No. 2, 101-3 (1959). In German.
According to Kopal [Ann. Astrophys., Vol. 18, No. 6, 379-430
5)] the values of the total potential over free surfaces of both
ponents of close binary systems are sensibly equal for main-
ence systems, as is shown by an analysis of observational data.
is paper, this fact is explained as a general property of systems
isting of two main sequence stars. Therefore, an evolutionary
ificance must not be searched for this fact.

523.84

18801 PARALLAX AND MASS-RATIO OF THE VISUAL BINARY Ho 581 FROM PHOTOGRAPHS TAKEN WITH THE SPROUL 24-inch REFRACTOR.

L.W.Fredrick.

Astron. J., Vol. 65, No. 6, 382-3 (Aug., 1960).

Measurement and reduction of plates taken with the Sproul refractor over the intervals 1919-1923 and 1934-1958 yield +0″.0.16 ± 0″.004 for the relative parallax and +0″.079 ± 0″.004 for the semi-axial major of the photocentric orbit. An absolute parallax of =0″.0181 ± 0″.004 was adopted. The small value of the parallax does not permit a good determination of the combined mass of A and B. The mass function is found to have the unusual value of 0.32 to 0.68, the fainter component being the more massive.

523.84

18802 THE RELATIVISTIC PERIASTRON MOTION OF DI HER.

M.Rudkjøbing.

Ann. Astrophys., Vol. 22, No. 2, 111-17 (1959).

In the eclipsing binary system DI Her the relativistic part of the periastron motion is found to be larger than the part due to deformation of the components. This latter part is calculated on the assumption of a mass distribution inside the components similar to that of the components of Y Cyg. The total advance of periastron causes the periods of primary and secondary minima to differ by one second. Since the period of revolution is ten days, the present rate of change in the spacing of the minima is one hour per century.

523.84

18803 THE LIGHT VARIATION AND ORBITAL ELEMENTS OF AH VIRGINIS.

L.Binnendijk.

Astron. J., Vol. 65, No. 6, 358-73 (Aug., 1960).

Photoelectric observations are presented of 1110 yellow and 1082 blue magnitudes of AH Virginis which were obtained during 22 nights of observing, mostly during the spring months of 1955 and 1957. The period is variable and the shape of the light curve changes in a short time as is shown by the observations of five consecutive nights. One light curve observed in 1955 has an unusual appearance in that the heights of the maxima are unequal and the secondary minimum is asymmetrical and delayed. This curve was compared with a more nearly normal light curve, observed in 1957, which shows maxima of the same height and a symmetrical and undisplaced secondary minimum. Orbital elements were computed keeping the geometrical elements such as the inclination, the sizes and shapes of the components the same, while the photometric elements such as intensity and surface brightness were considered to vary during the two-year period of observation. A total eclipse occurs at primary minimum. Only the greater star is visible then and it is somewhat fainter in the 1955 light curve. The greatest difference between the 1955 and 1957 light curves occurs at secondary maximum (phase 0.75). It is shown that the unusual appearance of the 1955 light curve was caused by a subluminous region on the greater star. This region was located near one of the endpoints of the equatorial b axis, which exceeds the Jacobian limiting surface.

523.84

18804 PHOTOELECTRIC LIGHT CURVES OF XY LEONIS.

R.H.Koch.

Astron. J., Vol. 65, No. 6, 374-80 (Aug., 1960).

Yellow and blue light curves of XY Leonis were obtained. There are small differences between the best orbital elements derived at each wavelength. Neither solution agrees with the one expected from spectroscopic observations. A possible cause of the discrepancy is discussed and a limiting photometric solution computed.

523.84

18805 PERIODS OF FIFTY-EIGHT MIRA-TYPE VARIABLES.

B.S.Whitney.

Astron. J., Vol. 65, No. 6, 381-2 (Aug, 1960).

New periods or epochs have been determined for 42 Mira-type stars. For 16 others, epochs and residuals are provided which may be useful in future studies of their periods.

523.84

18806 PARALLAX AND ORBITAL MOTION OF Hu 575 = ADS 9352 FROM PHOTOGRAPHS TAKEN WITH THE 24-inch SPROUL REFRACTOR.

S.L.Lippincott.

Astron. J., Vol. 65, No. 6, 383-4 (Aug., 1960).

Measurement and reduction of plates taken with the Sproul refractor over the interval 1933-1959 yield +0″.046 ± 0″.007 (p.e.) for ean relative parallax of ADS 9352 AB and its distant proper n companion C and +0″.014 ± 0″.016 for the semi-axis major of otocentric orbit of AB. The small value of the parallax com- with the uncertainty in the orbital elements does not permit determination of the combined mass of A and B. The mass s found to be 0.55 to 0.45

523.85

07 THE GRAVITATIONAL CONTRACTION TIMES OF STARS IN VERY YOUNG CLUSTERS. C.M.Varsavsky.

phys. J., Vol. 132, No. 2, 354-60 (Sept., 1960).

group of stars, presumably in gravitational contraction was ved photoelectrically; their spectra were investigated earlier (1949). The results of combining the two types of observa- indicate that, probably because of the influence of emission the B–V colour is not a good measure of the effective temper- of the star. For a given effective temperature a range in of up to 0^{m}8 is observed toward the blue side of the relation- or normal stars. Taking this effect into account, the author no discrepancy between the observed colour-magnitude dia- of very young clusters and those predicted from a theory of ational contraction.

523.85

08 THE ISOCHRON CLUSTER. I.

M.Hénon.

Astrophys., Vol. 22, No. 2, 126-39 (1959). In French.

a spherically symmetric globular cluster, the stellar orbits d upon 2 parameters: E, total energy, and A, angular momen- The condition is sought where the orbital period T depends pon E. Three cases are found: (a) mass concentrated at the ; (b) homogeneous cluster; (c) "isochron" cluster. The last s very similar to the case of real clusters, as shown by a com- n of the projected densities. A theoretical interpretation is sted. As a model, the isochron cluster seems better than s suggested by other authors.

523.85

09 THE ISOCHRON CLUSTER. II. ORBITAL CALCULATIONS. M.Hénon.

Astrophys., Vol. 22, No. 5, 491-8 (1959). In French.

523.85

10 THE ISOCHRON CLUSTER. III. DISTRIBUTION FUNCTION. M.Hénon.

Astrophys., Vol. 23, No. 3, 474-7 (1960). In French.

he distribution function in an isochron cluster (model of a ar cluster) is calculated, under the hypothesis that the velocity bution is isotropic at each point.

523.85

11 GLOBULAR CLUSTERS. I. THE RADIAL VELOCITIES OF SOUTHERN GLOBULAR CLUSTERS.

inman.

ly Not. Roy. Astron. Soc., Vol. 119, No. 2, 157-73 (1959).

523.85

12 GLOBULAR CLUSTERS. II. THE SPECTRAL TYPES OF INDIVIDUAL STARS AND OF THE INTEGRATED

T. T.D.Kinman.

ly Not. Roy. Astron. Soc., Vol. 119, No. 5, 538-58 (1959).

he problem of classifying the spectra of individual stars and a taken in integrated cluster light is discussed. Types are to the spectra of both kinds previously discussed in Pt I and a arison is made with Mayall's and also Morgan's classification ectra of lower dispersion. The effect of the metal/hydrogen on the metal line strengths in the spectra of the cluster giants cussed and an attempt is made to calculate this ratio for differ- usters from the present spectra. It is concluded that the /hydrogen ratio ranges from greater than 1/10 to less than the solar value for different clusters. A correlation is found en the integrated spectral type of a cluster and its concentra- the galactic plane. Clusters of the earliest spectral type stars have a very low metal abundance form an extended al distribution with little concentration to the plane, while f latest type whose stars have the highest metal abundance strong concentration to the plane: clusters of intermediate which are the most numerous, show an intermediate distribu- The less definite correlation between spectral type and the rties of the RR Lyrae stars is also discussed.

3.85

18813 GLOBULAR CLUSTERS. III. AN ANALYSIS OF THE CLUSTER RADIAL VELOCITIES. T.D.Kinman.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 5, 559-75 (1959)

The solar motion found from the radial velocities of 70 globular clusters is 167 ± 30 km/sec with an apex which does not devia from the direction of the sun's galactic rotation. A small and scarcely significant apparent contraction of the system is foun which could be produced by systematic errors in the velocities found from low dispersion spectra. The radial velocities provide no conclusive evidence for differential motion in the cluster system either as a function of galactocentric distance or of integrated spectral type: large errors are inherent in these solutions, however, because of the small samples of clusters available, their unfavourable galactic distribution and large peculiar motions. It is shown that field RR Lyrae stars of the same period range as those occurring in globular clusters have the same solar motion and velocity dispersion as the clusters; it is suggested that these stars and the cluster have a common origin. A scatter diagram of the ratio of the radial velocity to the circular velocity against the angle subtended at the cluster by the sun and the galactic centre confirms von Hoerner's conclusion that the cluster orbits are mainly highly eccentric. A high eccentricity (e = 0.8) is also found by considering the mean galactic rotation of the cluster system. A simple model is used to determine the distribution of mass in the Galaxy from the cluster motions. The results are consistent with Schmidt's model except possibly at galactocentric distances beyond 12 kpc. The mean angular momentum per unit mass of the cluster system and of the rest of the Galaxy is shown to be the same. The bearing of this on the origin of the cluster system is briefly discussed.

53.85

18814 DUST AND GAS IN GLOBULAR CLUSTERS.

M.S.Roberts.

Astron. J., Vol. 65, No. 8, 457-66 (Oct., 1960).

The possibility that dust and gas may exist in a significant amount in globular clusters is considered. It is shown that the only method of detecting such intraglobular matter at present is by its obscuring effects, especially if the material has collected into clouds within the cluster. Evidence is presented that such clouds exist in globular clusters, appearing as dark regions and lanes in the cluster. It is found that statistical fluctuations in the projected stellar distribution of the cluster cannot account for these dark regions. If these obscuring effects are attributed to foreground clouds one must expect at least 20 such clouds per square degree of sky at high galactic latitudes. It is concluded that such an explanation cannot account for all the obscured regions that have been found in globular clusters. The source of the intraglobular clouds can be satisfactorily accounted for by the mass shed by stars evolving to the white-dwarf stage. About 0.5% of the total mass of the cluster becomes available in this manner in the time between passages of the cluster through the galactic plane. The effects of such intraglobular matter on the stellar population of the cluster are discussed. Such clouds may condense into stars and thus account for those stars which lie in the vicinity of the main sequence and above the turnoff point in the colour-magnitude diagrams of some globular clusters. These stars appear to have a nonrandom distribution in the cluster, supporting the above suggestion as to their origin.

52.85

18815 ESCAPE VELOCITY IN GLOBULAR CLUSTERS.

H.L.Vanderlinden.

Meded. K. Vlaamse Acad. Wetensch., Vol. 21, No. 12, 10 pp. (195
In Flemish.

Assuming a Maxwell–Boltzmann distribution of the velocities of stars in a globular cluster, the probability of escape is K = 0.014, as already found by Chandrasekhar. This value is independent of the cluster model chosen and is constant everywhere in the cluster. The force function at distance r from the centre of the cluster is derived in the case of a Plummer–Schuster density distribution. The following values of the constants were adopted: central density ρ_0 = 400 solar masses/parsec^3, a = 3 parsecs, radius of the cluster R = 100 parsecs. They correspond to a centrally concentrated cluster of average dimension. With these values, the velocity of escape and the mean velocity are calculated at various distances from the centre of the cluster.

523.85

16 CAN SPHERICAL CLUSTERS ROTATE?
D.Lynden-Bell.

y Not. Roy. Astron. Soc., Vol. 120, No. 3, 204-13 (1960).

is shown that contrary to former belief an unrelaxed spherical : of mass points may rotate without becoming oblate. When f an unrelaxed system the argument that spherical objects do ate is thus false. Some present estimates of the sun's ar velocity round the galaxy rest on this argument applied system of globular clusters.

523.85

17 METHOD OF COMPUTING THE MASS DISTRIBUTION IN A STELLAR SYSTEM WITH SPHERICAL SYMMETRY, OSED OF STARS OF DIFFERENT MASSES. R.Bouciqué.

i. K. Vlaamse Acad. Westensch., Vol. 21, No. 1, 8 pp. (1959). emish.

he method is based on the assumption of isothermal equilibrium en the different groups of stars of the same mass. By introg other convenient assumptions, it is possible to reduce the em to a knowledge of the mass distribution in any one of the s.

523.85

8818 NON-STEADY SOLUTIONS OF STRATIFIED SELF-GRAVITATING STELLAR SYSTEMS. R.Van der Borght.

ed. K. Vlaamse Acad. Westensch., Vol. 21, No. 9, 11 pp. (1959).

It is shown that, for an arbitrary velocity distribution function, nly solution to the problem of non-steady stratified self-itating stellar systems is similar to those found by Camm 0) for two particular forms of the distribution function.

523.85

319 SEARCH FOR γ RADIATION FROM THE CYGNUS A RADIOSOURCE.
accesi, M.Ceccarelli and G.Salandin.

o Cimento, Vol. 17, No. 5, 691-4 (Sept. 1, 1960).

An experiment is described attempting to detect energetic diation from a peculiar celestial object (Cygnus A) interpreted ome authors as a collision between a galaxy of matter and one ti-matter. The experiment was negative and settled as upper t for the γ-flux a value of about 5×10^{-3} quanta/cm^2 sec, which out two orders of magnitude smaller than estimated by rison under the assumption previously mentioned.

523.85

8820 NEW PLANETARY NEBULAE (P.N.) WITH TWO SHELLS. G.A.Gurzadyan.

1. Akad. Nauk SSSR, Vol. 133, No. 5, 1053-4 (Aug. 11, 1960). ussian.

A study of the Palomar Atlas reveals that ten p.n. (including of special interest, NGC 6543) previously classified as type I e shell) or type III (annular) are in reality of type II (two shells). list of type II p.n. now amounts to about 30—almost ⅓ of all p.n. ery p.n. probably starts its life with one shell and ends it with . Type II is a transitional form which merges into type III n the second shell becomes invisible owing to its rate of expan-n.

G.A.Chisnall

523.85

18821 ON THE POSSIBILITY OF THE FORMATION OF FILAMENTARY STRUCTURES BY TWISTING.
.Pikel'ner and R.E.Gershberg.

tron. Zh., Vol. 36, No. 5, 785-93 (1959). In Russian. English nslation in: Soviet Astron.—AJ (New York), Vol. 3, No. 5, 765-72 arch-April, 1960).

The possibility is considered of the formation of filaments, mmon in nebulae and other cosmic objects, by a mechanical ch-effect. If the ends of a tube of magnetic-force lines are nnected with two dense vortices rotating in opposite directions, n it can be assumed that in some part of it there is a linear pendence between the angular velocity and z. The problem is lved without accounting for the Joule losses. The field Hφ, arising a result of twisting, compresses the gas towards the axis. The density stribution at some instants of time and for different conditions is ven. The role of damping is estimated for the stationary case. It negligible for H II regions of interstellar gas, but prevents the rmation of filaments in H I regions and in the chromosphere. The ergy of the vortices necessary for compression appears to be ceptable. The stability of the filaments formed is briefly discussed.

5

18822 ON ANALYSING THE PHYSICAL EVOLUTION OF GALAXIES. V.C.Reddish.

Proc. Roy. Soc. Edinburgh A, Vol. 65, Pt 3, 207-22 (1960).

Investigations based on gas masses, bright star counts, anc luminosity-mass ratios of galaxies lead to one of two conclusio If the galaxies are all of the same age, the faint ends of the initi luminosity functions of stars at formation differ greatly from o galaxy to another. On the other hand consistent results in the analysis are obtained with luminosity functions, that are more nearly constant and ages which range from one to thirty thousar million years. The various possibilities can be tested by obser tions on the Magellanic Clouds. Equations are set up which des cribe, as functions of time, the integrated properties of a galax as a system of stars and gas.

5

18823 THE LOCAL SUPERCLUSTER OF GALAXIES.
Zh. de Vokuler [G.de Vaucouleurs].

Astron. Zh., Vol. 36, No. 6, 977-93 (1959). In Russian. Engli translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 6, 897-912 (May-June, 1960).

The historical background for the notion of superclustering clustering of the second order of galaxies is briefly reviewed. evidence for superclustering among the brighter galaxies is the discussed in some detail, including the initial indications of lar scale rotation in the universe. The new studies of the local sup cluster (beginning from 1951-52) are described; maps of the galactic and supergalactic distribution of bright galaxies are gi the north pole of the supergalaxy is at $l = 15^0$, $b = +5^0$; the nucle is in the Virgo cluster. The concentration of galaxies of differe magnitudes to the supergalactic plane is determined; the over-a diameter of the supersystem is about 30 Mpc, if the distance R_1 the nucleus is 10 Mpc. The new evidence for differential rotatio and expansion of the local supercluster is summarized and illus trated; a simple model is described, which accounts quantitative for the nonlinearity and nonisotropy of the velocity field among galaxies brighter than the 14th magnitude. The rotational comp nent of the velocity of the galaxy is about 500 km per sec from $L = 194^0$ ($l = 187^0$, $b = -14^0$); the mass of the supercluster is abo 10^{15} solar masses, the period of revolution varies from 50×10^9 near the centre, to $100\text{-}200 \times 10^9$ years in the outer regions. A application to the calibration of the Hubble expansion parameter outside the local supercluster gives $H = 174$ km/sec per Mpc if $R_1 = 10$ Mpc (140 if $R_1 = 12.6$ Mpc). The conflicting evidence on radio emission from the local supercluster is reviewed.

5

18824 ON TIDAL INTERACTION BETWEEN GALAXIES.
P.O.Lindblad.

Stockholms Obs. Ann., Vol. 21, No. 3, 38 pp. (1960).

The theory of gravitational interaction between double gala is developed to some extent with emphasis on the resonance eff that arise in a region where the rate of advance of the apsidal li of an orbit is equal to the angular motion of the components. T resonance effects are illustrated by numerical computations wi an electronic computer using the Schmidt model of the force in galactic plane. The possibility of ejection of matter to large distances is demonstrated. The ejection will be directed into a main stream and a weaker counter-tide in the oppsite direction. The effect of a moderately close passage by a field galaxy is de strated too in a numerical example.

5

18825 THE DEVELOPMENT OF SPIRAL STRUCTURE IN GALAXY APPROACHED BY NUMERICAL COMPUTATIONS. P.O.Lindblad.

Stockholms Obs. Ann., Vol. 21, No. 4, 73 pp. (1960).

The behaviour of numerical mass-point models of ring sha configurations in the central layer of a galaxy is integrated with electronic computer. Initial deviations from rotational symmet are realized in two different ways: (1) A slightly elongated mass ring, the apsidal line of which proceeds with the angular velocit of the apsidal line of a dispersion orbit, is introduced. This "di sion" ring will have a considerable degree of stability, dispersi matter being mainly along the ring. Its disturbing influence on circular motions in a surrounding, not very massive central lay is considered. It is suggested that the action from a potential w of this kind is responsible for the extended outer rings common spiral galaxies of early type. The interactions between a disper ring and outer massive rings are also discussed; they first result in the development of a tightly wound spiral structure with leading arms that, at a later stage, tend to shift over into trailing ones. (2) In the second case a circular ring is given a bisymmetrical density variation along its circumference which proceeds with approximately the angular velocity of circular motion. This density wave is intimately related to the structure of a "bar" in the system. A central layer of circular motions proves to be unstable for a rather small amplitude of the density variation, and breaks up under the formation of a spiral pattern. The developments of the most important models are shown in a series of diagrams. Also, in this case, the spiral arms come into being as leading ones, and a bar grows out of the initial density wave. The arms are drawn into the ends of the bar and generally, at a later stage, tend to change over into trailing ones.

523.85

18826 ON THE MAGNETIC FIELD OF THE GALAXY. F.Hoyle and J.G.Ireland.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 2, 173-86 (1960).

The view that the spiral arms of the Galaxy are tubes of force winding into, and out of, the galactic nucleus is considered. It is shown that the winding of such a tube in the differential rotational field of the Galaxy leads to a degree of wrapping of about the observed order in a time interval as short as 400 million years. It appears likely that a further winding of the field must lead to the outbreak of instabilities in which loops of the magnetic field emerge out of the plane of the Galaxy. It is suggested that the magnetic field of the galactic halo is built from a multitude of such loops. The rate at which energy passes from the orbital motion of gas in the Galaxy, first into magnetic energy, and then into random dynamical turbulence is computed. The result is 10^{-27} erg cm^{-3} sec^{-1}, a value in close agreement with the estimated rate of dissipation of the turbulence of the interstellar gas.

523.85 : 522

18827 OPTICAL DETERMINATIONS OF THE GALACTIC POLE. A.Blaauw.

Monthly Not. Roy. Astron. Soc., Vol. 121, No. 2, 164-70 (1960).

A discussion is given of two new determinations of the galactic pole, based on recent surveys of distant OB stars and Cepheids. It is shown that, within the observational uncertainty, the plane defined by all optical objects observed between 1000 and 4000 pc from the sun is parallel to the plane defined by the neutral hydrogen. It is concluded, however, that the optical objects should be used in the determination of a new galactic pole because (i) they represent a very limited sample of the Galaxy, (ii) they are not free from the influence of observational selection (absorption), (iii) they are partly situated in the outer distorted regions of the Galaxy and (iv) they are closely related to the neutral hydrogen and therefore not really independent.

523.85

18828 A STUDY OF NEUTRAL HYDROGEN IN THE SOLAR NEIGHBOURHOOD OF THE MILKY WAY. R.D.Davies.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 5, 483-97 (1960).

The distribution of neutral hydrogen away from the galactic plane has been measured between Dec. = $+90^\circ$ and Dec. = -32°. It shows a number of neutral hydrogen clouds which coincide in position with dust complexes. The major feature of the distribution is the excess of neutral hydrogen in the position of the local system (Gould's Belt) of early-type stars and dust. The system ($\sim 10^5\ M_{\odot}$) appears to represent a later formation in the local spiral arm. An extended region in Cepheus is probably similar.

523.85

18829 NOTE ON THE TRANSFERENCE OF ANGULAR MOMENTUM WITHIN THE GALAXY THROUGH THE AGENCY OF A MAGNETIC FIELD. F.Hoyle and J.G.Ireland.

Monthly Not. Roy. Astron. Soc., Vol. 121, No. 3, 253-9 (1960).

It is shown that, under favourable conditions, the conventional picture of the orientation of the magnetic field in the spiral arms of the Galaxy can explain the outward motion of gas at a radial speed of ~ 50 km sec^{-1} within the central regions of the Galaxy. Such a motion cannot arise, however, unless at a greater distance from the galactic centre there is a corresponding inward motion. The failure to observe such an inward motion casts doubt on the correctness of the conventional picture of the magnetic field.

5 .8

18830 THE SPATIAL STRUCTURE OF SEVERAL CLUSTE S OF GALAXIES. A.S.Sharov.

Astron. Zh., Vol. 36, No. 5, 807-15 (1959). In Russian. English translation in: Soviet Astron.—AJ(New York), Vol. 3, No. 5, 784-92 (March-April, 1960).

The spatial structure of clusters of galaxies in the constell Coma Berenices, Cancer and Hydra was considered. The count of galaxies published by Zwicky and the method elaborated by Kholopov (1949, 1953) were used for the analysis.

5 .8

18831 SOUTHERN HEMISPHERE PHOTOMETRY. VIII. CEPHEIDS IN THE SMALL MAGELLANIC CLOUD.

H.Arp.

Astron. J., Vol. 65, No. 7, 404-44 (Sept., 1960).

For Pt VII, see Astron. J., Vol. 64, No. 7, 254 (Sept., 1959) Photographic and photovisual data are presented for 69 cepheids in the Small Magellanic Cloud. The region investigated is centr on NGC 371 and has a projected area of about $1^\circ \times 1^\circ$. The new photoelectrically calibrated magnitude scales are compared to t previous Harvard magnitudes and corrections reaching $\frac{1}{2}$ magnit at B = 17.5 mag. are noted. Light curves in B and V are presen for 64 of the cepheids. The light curves compare well in genera shape wherever previous Harvard light curves are available, bu they do not correspond well in secondary details, such as "bump" Periods determined in the span 1955-1956 are given, together w their estimated uncertainties. An indication that some of these cepheids are shortening their periods is discussed. Magnitude a mean light intensity, $\langle B\rangle$ and $\langle V\rangle$, are obtained by a method of correcting magnitude means. $\langle B\rangle$, $\langle V\rangle$, and the light curve parameters of amplitude, asymmetry, and rate-of-rise are given for he cepheids. The average error in $\langle B\rangle$, $\langle V\rangle$ magnitudes for the brht cepheids is estimated to be ±0.03 mag., increasing to about ±0.0 mag. for the fainter cepheids. The residuals from the mean peri apparent magnitude relation, $\Delta\langle B\rangle$, and the residuals from the mean colour-magnitude relation, $\Delta(\langle B\rangle - \langle V\rangle)$, are tabulated. Cepheids which are intrinsically redder than average are expect to also be intrinsically fainter than average. In fact, the intrinsi ratio of $\Delta\langle B\rangle^0$ to $\Delta(\langle B\rangle - \langle V\rangle)^0$ is so close to the reddening-to absorption ratio that the close correlation which exists between these residuals cannot be used to determine the reddening for the cepheids. Instead, a method is developed whereby only $\langle B\rangle$ and t amplitude, $B_{min} - B_{max}$, are needed to obtain absorption for individual cepheids. To accomplish this it is shown that the residus from the mean period-amplitude, period-asymmetry and period-rate-of-rise relation is large compared to observational errors. Therefore, the shape of the light curve as indicated by these parameters is indicative of where a cepheid falls in the instability ga in the colour-magnitude diagram. Because the absorption in the particular SMC field investigated is not large, the intrinsic relati between $\Delta\langle B\rangle$ and $\Delta(B_{min} - B_{max})$ is not scattered beyond recognition. Deviations from the inferred narrow, intrinsic relation ca be measured and attributed to absorption. The mean reddening i the field determined in this way is $\langle E_{B-V}\rangle = 0.06$ mag. This value checks very well with the mean reddening determined from three-colour measures of supergiants in this field. Because this method of determining reddening only requires B light curves, an because the absorption measures are 4 times the reddening, the method seems promising for use in faint galaxies where accurate colour measures are difficult. All the cepheid parameters are th corrected individually for reddening and absorption, and tabulated The unreddened period-colour and colour-magnitude relations are shown. The P—L relations are:

$$\left.\begin{array}{l}\langle B\rangle^0 = 17.45 - 2.25 \log P\\ \langle V\rangle^0 = 17.05 - 2.47 \log P\end{array}\right\}\ \begin{array}{l}\text{eye estimated linear fit of unreddened}\\ \text{magnitudes at mean light.}\end{array}$$

From the position of the unreddened points in the colour-magnitud diagram, the slope of the lines of constant period is empirically determined. On the assumption that the $P(\rho)^{1/2}$ = const law is appl able to cepheids, the $\log T_e$, $(\langle B\rangle - \langle V\rangle)^0$ relation which is needed to predict the observed slope of the constant period lines is computed. The effect of nonhorizontal evolution through the cepheid gap, indicated by young SMC star clusters, is included in the computation. The empirically determined slope of the lines of constant period is confirmed by its prediction of the observed dispersion about the P—L relation and its prediction of the observ slope of the $\Delta(\langle B\rangle - \langle V\rangle)^0$, $\Delta\langle B\rangle^0$ relation. One cepheid in the

ıt sample is like the cepheids with periods around one day and
r, and at about $B = 17$ mag., which Detarayet and Landi Dessy
d to be members of the SMC. The results on the cepheid
ved here, $P = 1^d$, suggest that this group is probably varying
ıer modes and bears the same relation to the longer period
epheids as the RR Lyrae c types do to the RR Lyrae a and
s. It is pointed out that cepheids appear to evolve through the
the SMC clusters along a line of constant period. This circum-
e may be accidental, but, if it is not, there seems to be no
ıation for why it is so.

523.85

32 GALACTIC AND EXTRAGALACTIC RESEARCH AND ELECTRONIC PHOTOGRAPHY.

Astrophys., Vol. 23, No. 3, 305-466 (1960) [Colloques
ıationaux du Centre National de la Recherche Scientifique
5]. In French.
he conference was held from 30 June to 3 July 1959 at the
.S. under the direction of Prof. Darjon, Director of the Paris
vatory and the Institut d'Astrophysique. 24 papers were read.
acts of some of these papers will appear in this or succeeding
s of Physics Abstracts.

523.85

8833 OBSERVATION OF GALAXIES AND COSMOLOGICAL MODELS. P.Couderc.

Astrophys., Vol. 23, No. 3, 397-402 (1960). In French.
"Galactic and extragalactic research" Conference (see Abstr.
2 of 1960). The choice between cosmological models depends
the certainty of the evaluation of apparent and absolute magni-
s of galaxies. After the recent re-evaluations of distances,
r errors remain: selectivity effects studied by Scott, aber-
on, absorption and evolution. It is also desirable to replace
ographic magnitudes by bolometric measurements.

523.85

8834 ON THE INTERPRETATION OF THE SPIRAL STRUCTURE IN THE GALACTIC SYSTEM. G.Münch.

. Astrophys., Vol. 23, No. 3, 403-9 (1960).
"Galactic and extragalactic research" Conference (see Abstr.
32 of 1960). The interpretation of galactic structure by means
ıe 21 cm hydrogen line is connected with the hypothesis of a
ular motion of the interstellar gas. Some systematic relative
ions between remove O and B stars and gas have been found
ugh measurements of radial velocities and interstellar absorp-
lines. Electronic photography should help to extend such
lies.

523.85

18835 ON THE PHOTOELECTRIC MEASUREMENT OF GALACTIC AND EXTRAGALACTIC DISTANCES.

ouigue.
.. Astrophys., Vol. 23, No. 3, 444-50 (1960). In French.
"Galactic and extragalactic research" Conference (see Abstr.
32 of 1960). In the first paragraph, the author discusses the method
neasuring galactic and extragalactic distances by photoelectric
ervations. A new method is proposed that gives a better deter-
ıation of intrinsic photometric properties of supergiants. An
provement of fundamental constants, using the electronic camera,
suggested. In the second paragraph, another programme of
ervations of elliptic galaxies by the electronic telescope is
posed. It should permit the maximum exploitation of the results
he photoelectric measurements.

523.85

18836 THE CENTRAL CONDENSATION OF THE GALAXY. J.Dufay.

n. Astrophys., Vol. 23, No. 3, 451-64 (1960). In French.
"Galactic and extragalactic research" Conference (see Abstr.
832 of 1960). The absorption in front of the great stellar cloud disco-
red by infrared photography around the direction of the centre of the
lky Way is evaluated by three different methods. The observation of
ıew globular cluster which is practically invisible in blue light and
ıich apprently lies in the cloud, leads to the belief that this cloud
longs to the central condensation around the centre of the Galaxy,
ıd not to a spiral arm between the sun and the centre. Colour
cesses of blue giants, measured by Hiltner in this direction, give
partial localization of absorbing clouds which are, in general,
ry close. The dimensions of the central condensation, including the great cloud of Sagittarius and the infra-red cloud are roughly estimated. They are comparable with the dimensions of the central condensation of the galaxy N.G.C. 4565 (Sb type).

523.87

18837 PROBLEMS OF EXTRAGALACTIC SPECTROSCOPY. R.Minkowski.

Ann. Astrophys., Vol. 23, No. 3, 385-96 (1960).

"Galactic and extragalactic research" Conference (see Abstr. 18832 of 1960). The author gives the characteristics of the most powerful spectrographs and their results in the fields of radial velocities, relative motions in clusters of galaxies, the rotation of galaxies or the correlation between spectral features and absolute magnitudes of galaxies. The gain in speed offered by photoelectric devices should lead to rapid progress in these fields.

523.85 : 530.12

THE ABERRATION OF EXTRAGALACTIC NEBULAE.

See Abstr. 18903

523.87

18838 STUDY OF THE MONOCHROMATIC EMISSION IN THE REGIONS OF STRONG STELLAR CONCENTRATION. G.Courtès and P.Cruvellier.

Ann. Astrophys., Vol. 23, No. 3, 416-18 (1960). In French.

"Galactic and extragalactic research" Conference (see Abstr. 18832 of 1960). Description of a monochromatic radiation selector which gives a contrast 75 times greater than the combination of a filter and a photographic plate. Faint emission in high stellar density regions can be detected. It is possible to use a Jacquinot—Dufour spectrometer to measure the radial velocity of the emission nuclei of extragalactic nebulae.

523.87

18839 ON POSSIBLE MECHANISMS OF EMISSION OF DISCRETE GALACTIC OBJECTS IN THE SPECTRAL REGION 1225-1350 A.

S.B.Pikel'ner, I.S.Shklovskii and G.S.Ivanov-Kholodnyi.

Astron. Zh., Vol. 36, No. 2, 264-8 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 2, 263-6 (March-April, 1959).

The possibility of explaining the emission of discrete galactic sources, observed in the spectral region 1225-1350 A, by the usual mechanisms is examined. However, this explanation makes necessary the assumption that the absolute values of brightness of galactic sources in this spectral region were considerably overestimated. Separate sources (for example α Vir) are identified with H II regions in the neighbourhood of hot stars; up to now they have not been observed in H_α because of their low luminosity.

523.87

18840 CORPUSCULAR EMISSION FROM EARLY-TYPE STARS AS A POSSIBLE CAUSE OF EMISSION FROM NEBULAE IN THE REGION 1225-1350 A. I.S.Shklovskii.

Astron. Zh., Vol. 36, No. 4, 579-84 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 4, 569-74 (Jan.-Feb., 1960).

Elementary processes taking place during the passage of corpuscles ejected by a hot star through a gas nebula are considered. Charge-exchange reactions in the ground and excited states and also excitation and ionization due to collisions will be most significant. As a result of such processes the corpuscles will loose energy, mainly in the form of L_α quanta with large frequency shifts. This explains the ultraviolet emission from nebulae detected by means of rockets. The scattering of L_α quanta in the nebula by fast corpuscles, some of which have become partly neutral, is an additional source of emission. Thus, the source of ultraviolet emission from gas nebulae may be the intense stellar corpuscular emission, the energy of which is comparable to, or even sometimes greater than, that of the photon emission from these stars.

523.87

18841 THE MAGNESIUM b LINES IN LATE-TYPE STARS. T.J.Deeming.

Monthly Not. Roy. Astron. Soc., Vol. 121, No. 1, 52-75 (1960).

The absorption lines of Mg I at λ 5167-84 A have been measured photoelectrically in 539 Go-K_5 stars. The results show an increasing absorption with advancing spectral type and a negative absolute luminosity effect. No significant differences are found between the strong and weak line groups of Roman or between weak-CN and strong-CN stars. High velocity class III stars have slightly stronger Mg than normal. It is suggested that the Mg b lines can be used as a good criterion of the MK luminosity class for stars with B-V between 0.70 and 1.30, and as a fairly good criterion of MK spectral type between G8 and K_3.

523.87 : 535.43

18842 THE BRIGHTNESS OF A SPHERICAL NEBULA.

V.V.Sobolev.

Astron. Zh., Vol. 37, No. 1, 3-8 (1960). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, 1-6 (July-Aug., 1960).

The problem of light scattering in a homogeneous sphere with an energy source in its centre is considered, an arbitrary indicatrix of scattering being assumed. An approximate solution of the problem is given. Possible applications to dust nebulae are discussed.

523.87

18843 THE INVESTIGATION OF THE LINES OF HEAVY ELEMENTS IN THE SPECTRA OF PLANETARY NEBULAE.

A.A.Nikitin.

Astron. Zh., Vol. 36, No. 5, 778-84 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 5, 759-64 (March-April, 1960).

The N III recombination spectrum of planetary nebulae was analysed. The occupation of the different levels of the electron configurations $1s^2 2s2p$ + (3s, 3p, 3d, 4p) and $1s^2 2s^2$ + (3s, 3p, 3d...) of N III was studied qualitatively. The N III ionization due to the ejection of the outer 2p and inner 2s electrons in planetary nebulae was studied.

523.87

18844 RELATIVE INTENSITIES OF O I FORBIDDEN LINES IN AN EXPANDING ATMOSPHERE.

L.Houziaux.

Ann. Astrophys., Vol. 23, No. 1, 62-74 (1960). In French.

Relative intensities of red and green O I lines are obtained for eight types of diluted atmosphere expanding at uniform rate. The size of these atmospheres can be deduced from relative intensities of red and green lines or from the red lines only.

523.87

18845 UTILIZATION OF THE CENTRAL INTENSITIES OF THE BALMER LINES FOR DETERMINING THE SURFACE AND BRILLIANCE TEMPERATURES, AND APPARENT DIAMETER OF 33 STARS.

G.Cayrel de Strobel.

Ann. Astrophys., Vol. 23, No. 2, 278-98 (1960). In French.

Surface and brightness temperatures have been determined for 33 stars by a previously presented method (see Abstr. 8457 of 1950). From the results the limb darkening constant, the apparent diameters of the stars and their radii are deduced when the parallax is known. A critical discussion of the basic hypotheses of the method is outlined.

523.87

18846 PHOTOELECTRIC MEASUREMENTS OF THE λ4200 A CN BAND AND THE G BAND IN G8-K5 SPECTRA.

R.F.Griffin and R.O.Redman.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 4, 287-316 (1960).

A description is given of a rapid method of using a spectrometer to give reproducible photoelectric measures of integrated intensities over significant features of stellar spectra, without the necessity for a sky of photometric quality. The accuracy achieved is 1 per cent. The λ4200 A CN band has been measured in 712 late-type stars and the G band in 212 of these. Absolute magnitudes derived from CN intensities have mean errors of at least $1^{m}.5$. There is only a weak correlation of weak CN with high space velocity. "Weak-line" stars have no anomaly in their CN absorption; "strong-line" stars have slightly enhanced CN. For G to K1 stars the spectral type deduced from G band intensities has a mean deviation of 0.15 class from the MK type. There is a small absolute magnitude effect, the G band strengthening with intrinsic luminosity. High-velocity stars have completely normal G band intensities. "Weak-line" stars show the G band very slightly stronger, "strong-line" stars show it slightly weaker than the mean, but the individual scatter is fairly large and the difference between the two groups is scarcely significant statistically.

523

18847 PROCEEDINGS OF THE SYMPOSIUM ON CONSTITUTION OF STARS.

Proc. Nat. Acad. Sci. India A, Vol. 26, Pt 6, 431-75 (Nov., 1957).

Held at University of Lucknow, Dec., 1955. Following a pre dential address by A.C.Banerji, six papers were read: Exchang potential and the mass-radius relation for cold bodies. P.Lal an P.L.Bhatnagar; Method of separation (in astrophysical problems G.Bandyopadhyay; Evolution of stars on the upper main sequence R.S.Kushwaha; A possible interpretation of the H—R diagram for pleiades based on modern theory of stellar structure. A.G.Mass-vitch; Evolutionary trends in close binary systems. Z.Kopal; On evolution connection between stars and nebulae. V.A.Ambartsum

523

18848 THE LATER STAGES OF STELLAR EVOLUTION.

A.G.Masevich.

Astron. Zh., Vol. 36, No. 5, 794-9 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 5, 773 (March-April, 1960).

Stellar models with partially degenerate isothermal cores [Ψ_0 = 0; 2; 5] constructed by Kaminisi (1956) are discussed. Sim models for M = 0.5; 0.6; 0.7 $\odot$ are constructed. A comparison w observation shows that with the help of these models the structur white dwarfs as well as the place they occupy on the H—R diagra can be satisfactorily explained. The most important feature of s a model is the smaller degree of degeneracy for white dwarfs co pared with other models. The difficulties connected with a high probability of nuclear reactions at high densities pointed out by Zeldovitch (1957) do not seem to occur in this case. The validity of the theoretical mass—radius relation (derived for completely degenerate configurations) for real white dwarfs is considered o basis of existing observational data. Schwarzschild's (1955) view on white dwarfs being the latest stage of evolution of red giant st are shown to meet with serious difficulties for stars with mass $> 1\ \odot$.

523.

18849 MODELS FOR MAIN SEQUENCE STARS.

J.M.Blackler.

Monthly Not. Roy. Astron. Soc., Vol. 118, No. 1, 37-44 (1958).

523.7

18850 SOME QUESTIONS ON THE THEORY OF STELLAR ATMOSPHERES. I. GRAVITY DETERMINATION.

R.Cayrel.

Ann. Astrophys., Vol. 23, No. 2, 233-44 (1960). In French.

Kolb's theory (1957) of hydrogen line broadening is applied t the computation of Hδ in the ζ Per (BIIb) spectrum. The resultin gravity is roughly half of that obtained in a previous paper (Cayrel, 1957) using the classical theory of Holtsmark. This new value is in very good agreement with other determinations from t mass luminosity relation and from the known masses and radii o the eclipsing binaries.

523.

18851 SOME QUESTIONS ON THE THEORY OF STELLAR ATMOSPHERES. II. NEW APPROXIMATION FORMULAE FOR THE CALCULATION OF RADIATION AND FL INTENSITIES.

R.Cayrel.

Ann. Astrophys., Vol. 23, No. 2, 245-9 (1960). In French.

New numerical formulae are given for computing the averag intensity of the radiation and the flux at any level in a stellar atmosphere.

523.7

18852 ON THE MEAN ABSORPTION COEFFICIENT IN THE COMPUTATION OF MODEL STELLAR ATMOSPHER OF SOLAR TYPE STARS.

A.Przybylski.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 1, 3-21 (1960).

The problem of reducing the general case to the grey one in computation of model stellar atmospheres was investigated for s type stars. It was found that: (i) the "absorption" mean defined the equation

$$\kappa_a = (1/\bar{I}) \int_0^\infty \kappa_\nu \bar{I}_\nu \, d\nu$$

and the "emission" mean

$$\kappa_e = (1/B) \int_0^\infty \kappa_\nu B_\nu \, d\nu$$

ımerically equal within about 1% throughout the whole atmo-
e and consequently the equation

$$\bar{I}(\bar{\tau}) = B(\bar{\tau}),$$

is strictly valid for the grey case, is also satisfied for the
rey solar atmosphere within about 1%; (ii) the radiation pressure

$$\kappa p_r = (1/F)\int_0^\infty \kappa_\nu F_\nu \, d\nu$$

ıe Rosseland mean require only small corrections to the grey
erature distribution in the computation of model stellar atmo-
es; (iii) if these corrections are disregarded both means lead
ıdel stellar atmospheres sufficiently accurate to account for
sible features of stellar spectra; (iv) other mean absorption
ıcients require large corrections to the grey temperature
ibution; and (v) at the optical depth $\bar{\tau} = 11.6$ the weight function
Rosseland mean is practically identical with that of the radia-
ıressure mean and similarly the weight functions of the "absorp-
mean and the "emission" mean approach each other very
ly.

523.877 : 538.3

853 MAGNETO-HYDROSTATICS OF STELLAR ATMOSPHERES. I. THE STABILITY OF THE AXIALLY
METRIC CASE. M.J.Laird.
hly Not. Roy. Astron. Soc., Vol. 121, No. 2, 197-200 (1960).

The equation governing a small perturbation in a rotating
ar atmosphere under gravity with an axially symmetric mag-
field, whose lines of force are confined to the meridional
es, is set up. A sufficient condition for stability is found to be
a certain quadratic form is positive definite.

523.877 : 538.3

8854 MAGNETO-HYDROSTATICS OF STELLAR ATMOSPHERES. II. THE AXIALLY SYMMETRIC EQUI-
RIUM CONFIGURATIONS. H.Bondi.
thly Not. Roy. Astron. Soc., Vol. 121, No. 2, 201-7 (1960).

It is shown how the equation of hydrostatic equilibrium may be
ıced to a form suitable for calculation in the axially symmetric
, full account being taken of gas pressure, gravity, and mag-
c forces. The nature of the solution is discussed, and a specially
ple case is worked out in detail.

523.877 : 538.3

18855 MAGNETO-HYDROSTATICS OF STELLAR ATMOSPHERES. III. THE AXIALLY SYMMETRIC EQUI-
RIUM CONFIGURATIONS (Continued). M.J.Laird.
ıthly Not. Roy. Astron. Soc., Vol. 121, No. 2, 208-12 (1960).

In Pt II (see preceding abstract), Bondi showed how the funda-
ıtal equation may be reduced to a form suitable for calculation in
axially symmetric case under certain assumptions. In the first
t of this paper, a more general method of effecting this reduction
iven, with an example. In the second part, this method is ex-
ied to the case when the star is rotating, under more restricted
umptions about the structure of the atmosphere.

523.877 : 534.22

18856 SHOCK WAVES IN STELLAR ENVELOPES. S.A.Kaplan and I.A.Klimishin.
tron. Zh., Vol. 36, No. 3, 410-21 (1959). In Russian. English
nslation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3,
-14 (Dec., 1959).

Physical properties of shock waves in stellar envelopes are
died, taking into account interactions with radiation. For sim-
city, steady-state shock waves are assumed. An expression for
Hugoniot curve for a shock wave in a mixture of gas and radia-
n is derived and properties of detonation—recombination shock
ves are considered. It is shown that the detachment of the outer
rt of the envelope of a red giant is possible. The influence of
diative cooling on the paremeters of a shock wave in stellar
velopes and some properties of shock waves in a degenerate
s are discussed.

523.877

18857 CORONAL EVAPORATION AS A POSSIBLE MECHANISM FOR MASS LOSS IN RED GIANTS. R.Weymann.
trophys. J., Vol. 132, No. 2, 380-403 (Sept., 1960).

The consequences of the possible existence of a corona of a red giant are investigated from a hydrodynamic point of view, under the assumption that deposition of mechanical energy is confined to a narrow layer just above the surface of the star. Because of the energy losses due to radiation, steady subsonic flows do not exist, and only under special circumstances can hydrostatic solutions exist. In contrast, steady supersonic flows can exist, and the mass loss accompanying them would be significant from an evolutionary point of view. However, investigation of the observational consequences of such flows rules them out because of the expected presence of lines displaced toward much higher velocities than those actually observed. Other possible models for mass ejection are briefly discussed.

523.877

18858 HEATING OF STELLAR CHROMOSPHERES BY SHOCK WAVES. R.Weymann.
Astrophys. J., Vol. 132, No. 2, 452-60 (Sept., 1960).

On the basis of a very simple model for the dissipation of energy by shock waves, the structure of the chromospheres of stars with very different values of the surface gravity is discussed. Sharp jumps in the temperature at certain critical points would be expected. Reasonable chromospheric structures follow from this model for dwarfs, but not for stars of very low surface gravity unless very long-period shock waves are considered. The question of the thermal stability of the solutions is discussed.

523.877

18859 THE DETERMINATIONS OF ABUNDANCES AND THEIR EXPERIMENTAL NEEDS. J.C.Pecker.
Ann. Astrophys., Vol. 23, No. 3, 366-72 (1960). In French.

"Galactic and extragalactic research" Conference (see Abstr. 18832 of 1960). The determination of line profiles are essential in research concerning the chemical composition of stars. The author shows in the case of neutral titanium in the sun that the method of equivalent width is insufficient. Even the multiplet procedure is much too imprecise.

523.877

18860 ON THE CLASSIFICATION OF OSCILLATIONS OF TWO SUPERPOSED FLUIDS. N.Bel.
Ann. Astrophys., Vol. 22, No. 6, 748-58 (1959). In French.

The author studies the stability of oscillations of the interface in a composite atmosphere. For waves in propagation parallel with this interface, and in the case of a dense fluid topped by another one less dense, there is a limiting wave length, depending upon the ratio of the densities of the two fluids, above which the perturbations cannot be propagated; the perturbations of short wave lengths which are propagated are stable. When the top fluid is the more dense, there is always at least one non-stable mode of perturbation, as is natural.

523.877

18861 ON THE PULSATIONAL THEORY OF STELLAR VARIABILITY. V. MULTILAYER SPHERICAL DISCRETE MODEL. S.A.Zhevakin.
Astron. Zh., Vol. 36, No. 3, 394-409 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3, 389-403 (Dec., 1959).

For Pt IV see Astron. Zh., Vol. 32, 124 (1955). A static distributed model of an envelope of a variable star is constructed. From it two discrete four-layer models are constructed, which differ from each other by the value of the mass of the outer layer. The nondiabatic oscillations of these models are calculated in a linear approximation.

523.877

18862 STUDY OF NON-RADIAL OSCILLATIONS OF ROCHE'S MODEL. I.Ottelet.
Ann. Astrophys., Vol. 23, No. 2, 218-32 (1960). In French.

Concerns the non-radial oscillations arising in Roche's model, with $\Gamma = 3/2$, and determines, in particular, the characteristics of those perturbations causing the model to become dynamically unstable.

523.877

18863 THE EXTENT OF H II REGIONS. S.R.Pottasch.
Astrophys. J., Vol. 132, No. 1, 269-71 (July, 1960).

Strömgren's formula for the radius of the ionized region around an exciting star has been modified by Jefferies and Pottasch (Abstr. 14450 of 1960) to allow for scattered radiation and the frequency variation of optical depth in the Lyman continuum. It is now reported that, for electron densities less than 10^5 cm^{-3}, the required modification can be reduced to Strömgren's formula multiplied by a correction factor depending effectively only upon the temperature of the exciting star. R.A.Newing

523.877

18864 THE FORMATION OF POPULATION I STARS. I. GRAVITATIONAL CONTRACTION. W.H.McCrea.

Monthly Not. Roy. Astron. Soc., Vol. 117, No. 5, 562-78 (1957).

523.877 : 523.14

18865 THE FORMATION OF POPULATION I STARS. II. THE FORMATION OF MOLECULAR HYDROGEN IN INTERSTELLAR MATTER. W.H.McCrea and D.McNally.

Monthly Not. Roy. Astron. Soc., Vol. 121, No. 2, 238-51 (1960).

For Pt I, see preceding abstract. An investigation is made of the possibility of molecule-formation (chiefly H) by surface-reactions on interstellar dust-grains. An attempt is made to derive as precise an expression as possible for the rate of formation in terms of the properties of the grains. The effect upon the rate of a collision between interstellar clouds is also considered. The case of interstellar CH is discussed; some of the difficulties encountered by Bate and Spitzer may be overcome if the possibility is recognized of the enhanced production of CH in the conditions produced by a collision between clouds. It follows that the type of process considered takes place with a fairly high efficiency. The case of H_2 is then considered. An efficiency comparable to that inferred in the case of CH would give a proportion of H_2 in ordinary interstellar matter in satisfactory agreement with Kahn's estimate of the amount required to cool the matter after heating by cloud-collisions. Such an efficiency would also explain why free atomic hydrogen would not be found with a density more than the order 100 atom cm^{-3}. If H is produced at the inferred rate, then if an ordinary interstellar cloud is compressed by a factor about 100 the material will mostly take the form of H_2. This is of much significance for the process of star formation. Moreover, this significance is likely to remain, even if the process of H -formation has about the lowest efficiency that could be admitted.

523.877

18866 THE STRUCTURE OF POPULATION II STARS. P.Demarque.

Astrophys. J., Vol. 132, No. 2, 366-79 (Sept., 1960).

Interior models for metal-deficient stars are constructed for values of $Z = 0.001$, $Z = 0.005$, and $Z = 0.01$, for masses ranging from 0.6 to 1.0 solar mass, and hydrogen content X varying from 0.75 to 0.99 by weight. The models have a structure similar to that of red dwarf stars, investigated by Osterbrock (1953). They have a radiative core and a convective envelope in adiabatic equilbrium. The energy production is due to the proton—proton reaction, and Keller and Meyerott's tables (1955) are used for the opacity. In order to know the depth of the convective zone and therefore the position of the star in the Hertzsprung—Russell diagram, the outer boundary conditions as given by the physical conditions in the subphotospheric layers must be determined. In the atmosphere of stars with effective temperatures in the vicinity of the sun's the temperature gradient does not approach the adiabatic gradient as soon as convection sets in; there is an intermediate zone where one has to take into account the effect of the super-adiabatic gradient. Model atmospheres are constructed, making use of the theory of the mixing length as developed by Biermann. Both cores and atmospheres were integrated with the help of the University of Toronto IBM 650 computer. Integrations for adiabatic envelopes have been given by Osterbrock (1953). The resulting models enable one to establish the respective positions for main sequences for stars of various compositions in the theoretical Hertzsprung—Russell diagram. It is found that the shifts in position between main sequences of different chemical contents do not exceed a few tenths of a magnitude, even in cases of extreme metal deficiency. This is in good agreement with recent observational results. The mass-luminosity law, nevertheless, is not unique for stars with different chemical abundances.

523.877 : 539.17

18867 STELLAR SYNTHESIS OF THE α-PARTICLE NUCLEI HEAVIER THAN Ne^{20}.

C.Hayashi, M.Nishida, N.Ohyama and H.Tsuda.

Progr. theor. Phys., Vol. 22, No. 1, 101-27 (July, 1959).

The rates of (α, γ) and (γ, α) reactions at temperatures ab 5×10^9 °K for α-particle nuclei, Ne^{20}, Mg^{24} Si^{28}. S^{32}, A^{36}, and a are calculated as well as of heavy ion reactions such as $C^{12} + C^{12} \rightarrow Ne^{20} + \alpha$. etc. The stellar condition, under which th cosmical abundances of the α-particle nuclei can be explained terms of the above nuclear reactions, is investigated by using results. At high temperature $T = 2 \sim 3 \times 10^9$ °K the cosmical abundances of α-particle nuclei can be reproduced by taking th matter density ρ as $1\text{–}10^2$ g cm^{-3}. Such a stellar condition ma realized in the supernova explosion. It is shown that, to explai cosmical abundances concerned by the equilibrium theory, $T \gtrsim 5 \times 10^9$ °K and $\rho \cong 10^8$ g cm^{-3} are required.

52

18868 PROBLEM CONCERNING PLEIONE. J.Crampin and F.Hoyle.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 1, 33-42 (1960).

An evolutionary paradox arises in the case of the star Ple The implications of this paradox are discussed and several pos lities for overcoming it are investigated. At first sight one wo d expect a star evolving from the main-sequence to become incr singly stable against rotation. It is shown, however, that incre central condensation decreases the moment of inertia of the st sufficiently to produce two distinct epochs during which any inial tendency towards rotational instability is rendered more acute. mass of Pleione must be of order $4\odot$ and the radius of order 2×10^{11} cm. The calculated age depends on the evolutionary in pretation adopted, one interpretation gives an age as low as 4.7×10^7 years, another gives an age as high as 1.4×10^8 years Rotational instability causes the star to shed a disk of material disk probably being magnetically coupled to the star. The wind of the field, arising through rotation, may well be responsible f the ultimate instability of the disk. The process of disk formati and disruption can be repeated many times, the general order o the time required for disruption being 100 years.

52.8

18869 ON THE MAIN-SEQUENCE BAND AND THE HERTZSPRUNG GAP. F.Hoyle.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 1, 22-32 (1960).

Stars evolve rapidly away from the main-sequence as soon an inert helium core develops. Evolutionary sequences have be computed for the masses $30.1\odot$, $8.94\odot$, $3.89\odot$, $1.52\odot$. These inte tions enable a band to be determined, the lower edge of the band being given by the zero-ago main-sequence and the upper edge the moment of formation of an inert core. Stars near the main-sequence should lie within this band (apart from aspect effects introduced by rapid rotation). A comparison is made with recen work by Blaauw on the Scorpio—Centaurus group. The stars of the nebular region within the group appear to have an age of abo 12.5×10^6 years, whereas the best theoretical age estimate for whole group is $\sim 26 \times 10^6$ years. The age determined by Blaauw from dynamical considerations is $\sim 20 \times 10^6$ years.

523.77

18870 ON THE POSSIBILITY OF HELIUM BURNING IN GI STARS IN A GLOBULAR CLUSTER.

H.Yamazaki, S.Sakashita and Y.Ôno.

Progr. theor. Phys., Vol. 21, No. 2, 355-7 (Feb., 1959).

An error is detected in the method of approximation used by Hoyle and Schwarzschild (Astrophysical Journal Suppl., Vol. 2, No. 13, 1955) which vitiates their prediction that for a model of 1.2 solar masses, the luminosity, L, $\cong$ 5000 $L_\odot$, and that if M_C (He core mass) $\cong$ 0.52 M, then the temperature of the core shoul rise high enough for helium burning to take place. The method described gives, for $M = 1.2\ M_\odot$, $L \cong 13\,500\ L_\odot$, and a central temperature of only 56×10^6 deg when $M_C = 0.61$ M.

G.A.Chis

25

18871 VERIFICATION OF EARTH'S "PEAR SHAPE" GRAVITATIONAL HARMONIC.

C.J.Cohen and R.J.Anderle.

Science, Vol. 132, 807-8 (Sept. 23, 1960).

Predictions of the orbit of the Transit 1B satellite were systematically in error until account was taken of a third-order gravitational harmonic. The amplitude deduced for this harmoni by O'Keefe (see Abstr. 11767 of 1959; 6627 of 1960) from the ard I orbit serves very well, even though the orbits and the ds of observation and orbit fitting for the two satellites are lifferent.

525

72 FUN IN SPACE.

L.A.DuBridge.

J. Phys., Vol. 28, No. 8, 719-23 (Nov., 1960).

fter-dinner address to Spring 1960 meeting of the American cal Society. Attempts to point out in simplified way the ng, as well as some of the more serious, problems which in connection with flight into space. Figures are given to nge some of the more fanciful claims about the value of the as a military base, noting the very large amounts of fuel ed to take weapons up to the moon and then to return them to . Some of the important research problems in physics and nomy which can be carried out by the use of space vehicles are erated. As examples of a space science enterprise, the results magnetic field measurements by the Pioneer V package are arized. The impractibility of using the moon and other planets lonies for the earth's excess population is also demonstrated.

525 : 621.396.946

873 A DISCUSSION ON SPACE RESEARCH.

Proc. Roy. Soc. A, Vol. 253, 450-541 (Dec. 29, 1959).

Ield in London November 1958. For abstracts of the papers bstr. 8484, 8522, 10403, 10424, 10490, 10534, 10541-4, 12339, , 13074 of 1960.

525

8874 PARTICULAR SOLUTIONS OF THE GENERAL PROBLEM OF THE TRANSLATIONAL-ROTATIONAL 'ION OF A SPHEROID ATTRACTED BY A SPHERE.

Kondurar'.

on. Zh., Vol. 36, No. 5, 890-901 (1959). In Russian. English slation in: Soviet Astron. —AJ (New York), Vol. 3, No. 5, 75 (March-April, 1960).

Gives solutions which can be applied to the translational-tional motion of a rocket around the earth or sun (assuming the rocket is homogeneous and has the appropriate symmetry), to interplanetary space stations in the form of a flattened eroid.

525

8875 ARTIFICIAL SATELLITES. I. THE MOTIONS OF ARTIFICIAL SATELLITES.

Sadler and G.A.Wilkins.

thly Not. Roy. Astron. Soc., Vol. 119, No. 4, 424-32 (1959).

The authors consider the astronomical information that can be ined from observations of the positions and motions of artificial h satellites. The results obtained so far, and the probable future ands on theory and observational technique are surveyed.

H.Morrison

525

8876 THE THEORY OF SATELLITE ORBITS, BASED ON A NEW COORDINATE SYSTEM.

.Brenner and G.E.Latta.

c. Roy. Soc. A, Vol. 258, 470-85 (Nov. 8, 1960).

The coordinate system of King-Hele is refined and used to ve the equations of motion of a near-earth satellite, neglecting perturbing forces except the oblateness of the earth. Besides better-known effects (regression of nodes, precession or ession of perigee), it is found that the maximum latitude of the satellite point varies, and the rate of regression of the node ies by as much as 20% on either side of its mean value (when 0.2). Validity of the analysis is not restricted to small entricities.

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18877 THE EFFECT OF ATMOSPHERIC ROTATION ON THE ORBITAL PLANE OF A NEAR-EARTH TELLITE.

G.E.Cook and R.N.A.Plimmer.

oc. Roy. Soc. A, Vol. 258, 516-28 (Nov. 8, 1960).

Besides the perturbations due to the gravitational field of the rth, the rotation of the earth's atmosphere produces a perturb- force on a satellite which effects the motion of its orbital plane. eoretical formulae are derived for the rotation of the orbital ane about the earth's axis and the change in orbital inclination of a near-earth satellite of small eccentricity (< 0.2) due to the influence of the atmosphere. It is assumed that the atmosphere is spherically symmetrical and has a density which varies exponentially with altitude. Comparison of the theoretical changes in orbital inclination show reasonably good agreement with those estimated from kinetheodolite observations, although the need for a slightly steeper theoretical curve is indicated. Although the rotation of the orbital plane is small, allowance must be made for it when making estimates of the harmonics of the earth's gravitational field.

525

18878 ON MR KING-HELE'S THEORY OF THE EFFECT OF THE EARTH'S OBLATENESS ON THE ORBIT OF A CLOSE SATELLITE.

P.J.Message.

Monthly Not. Roy. Astron. Soc., Vol. 121, No. 1, 1-4 (1960).

The relations are obtained between α and Ω, the parameters defining King-Hele's plane II (see Abstr. 11766 of 1959), and the osculating inclination and longitude of node. The secular motion of the node is thereby obtained in terms of mean osculating elements in a form comparable to that arising in Brouwer's treatment of the caronical equations. A modification is made to King-Hele's theory which removes the singularities in the Je terms of $d\Omega/d\Psi$, and it is also found that there are no terms of order Je^2 in α or Ω.

525

18879 SATELLITE ORBITS ABOUT A PLANET WITH ROTATIONAL SYMMETRY.

C.M.Petty and J.V.Breakwell.

J. Franklin Inst., Vol. 270, No. 4, 259-82 (Oct., 1960).

A closed-form solution is obtained for the orbit of an earth satellite which is influenced by the third harmonic in the potential in addition to the two dominant oblateness terms. The results are carried to the "second order" in the rates of the secular variations and in the periodic fluctuations. The secular equations are solved in closed form in two cases: when the inclination is closed to 63.4° and when it is not. In the former case, the stability and period of the slow oscillation of the perigee are discussed.

525

18880 RELATIVISTIC EFFECTS IN THE MOTION OF AN ARTIFICIAL EARTH SATELLITE.

A.F.Bogorodskii.

Astron. Zh., Vol. 36, No. 5, 883-9 (1959). In Russian. English translation in: Soviet Astron.-AJ (New York), Vol. 3, No. 5, 857-62 (March-April, 1960).

Einstein's field equations are used to derive the law of motion, taking into account the rotation of the earth. The equations of motion of a satellite are investigated employing the method of variation of elements. It is shown that secular relativistic perturbations are absent in the semimajor axis, the eccentricity and the inclination of the orbit to the earth's equator. Secular effects are found in the longitude of the nodes, the displacement of the semimajor axis and the time of perigee passage.

525 : 523.4

THE SECULAR ACCELERATIONS OF SATELLITES.

See Abstr. 18704

525

18881 SECULAR PERTURBATIONS IN THE THEORY OF MOTION OF AN ARTIFICIAL EARTH SATELLITE.

E.A.Grebenikov.

Astron. Zh., Vol. 36, No. 6, 1111-21(1959). In Russian. English translation in: Soviet Astron.—AJ(New York), Vol. 3, No. 6, 1023-32 (May-June, 1960).

The analytical determination of secular perturbations is considered in the first approximation, taking into account the flattening of the earth and air resistance. The model of the atmosphere proposed by Okhotsimskii et al. (Abstr. 4690 of 1958) was used for deriving the secular perturbations due to air resistance. The secular perturbations of the elements of the orbit of the satellite 1958 β2 were found from these formulae.

525

18882 PERIODIC DRAG PERTURBATIONS OF ARTIFICIAL SATELLITES.

I.G.Izsak.

Astron.J., Vol. 65, No. 6, 355-7 (Aug., 1960).

Short-periodic drag perturbations are investigated by a method which in essence is a development into Fourier series of the right sides of the differential equations for the elements a, e, ω, and M. The mean density distribution in the atmosphere is approximated by $\rho = 10^{-1.35}(h-55)^{-5}$. Apart from secular terms in the elements a, e, and M the first-order perturbations appear in the form of Fourier series. The computation of the perturbations has been programmed for the IBM 704.

525

18883 OSCULATING ELEMENTS DERIVED FROM THE MODIFIED HANSEN THEORY FOR THE MOTION OF AN ARTIFICIAL SATELLITE.

A.Bailie and R.Bryant.
Astron. J., Vol. 65, No. 8, 451-3 (Oct., 1960).

The modified Hansen theory for the motion of an artificial satellite, as developed by Musen (1959), represents the gravitational perturbations. The development takes the form of several trigonometric series with numerical coefficients and specified arguments. The result of the modified Hansen theory is the position vector of the satellite which is obtained by evaluating these series. In this paper the velocity vector and the six classical osculating elements are shown to be obtainable also from the series in the general theory. The ability to obtain osculating elements and/or velocity from the modified Hansen theory is considered a significant adjunct to that theory. Comparison with other general perturbations theories and with special perturbations techniques is now possible. Accurate transition from the general theory to numerical integration makes it possible to transfer to the latter method when additional disturbing forces, not included in the general theory, become of consequence.

525

18884 THE COMPUTATION OF EXACT AND APPROXIMATE EPHEMERIDES OF ARTIFICIAL EARTH SATELLITES.

M.S.Yarov-Yarovoi and E.A.Grebenikov.
Astron. Zh., Vol. 36, No. 3, 524-34 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3, 510-19 (Dec., 1959).

Analytical methods for the solution of four main problems which arise during the computation of the ephemerides of artificial earth satellites are presented. The first problem is the determination of the interval of latitudes in which observations (optical and photographic) of the satellite can be made, the second is the computation of the exact ephemerides. In this case the main requirements are: 1) the determination of the time when a point with a given latitude intersects the orbital plane of the satellite, 2) the determination of the time when a satellite crosses a given parallel of latitude. Therefore, the ephemerides of a satellite should be calculated only for the intervals of time when the first and second moments of time are close to one another, i.e. when the satellite is at maximum height when observed from a given point. The fourth problem is to determine whether the brightness of the sky at twilight will interfere with observations, and whether the satellite will be in the earth's shadow. The latter problem has to be solved frequently if the point of observation is near the limits of the latitude interval, as found for the first problem. A numerical example is given at the end of the paper.

525

18885 ON THE STABILITY OF REGULAR MOTIONS OF ARTIFICIAL CELESTIAL BODIES.

G.N.Duboshin.
Astron. Zh., Vol. 36, No. 4, 723-33 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 4, 702-12 (Jan.-Feb., 1960).

Considers the motion of an artificial satellite around the earth, which is assumed to be a homogeneous sphere, the satellite having an arrow-like form which can, dynamically, be likened to a rectilinear homogeneous material segment (designated a "rod"). No forces other than the attraction of the earth are taken into account, and the resistance due to the terrestrial atmosphere is neglected. Under these conditions, the differential equations for the relative motion of a satellite around the earth have certain special solutions corresponding to the simplest motions of the satellite and these are defined as "regular". In these regular cases, the centre of inertia of the satellite, i.e. the centre of the rod, describes a circular orbit around the earth while the rod itself retains a constant orientation relative to this orbit. Three cases are possible, each corresponding to a regular motion of the rod. They are designated "arrow", "float" and "spoke". In the first case ("arrow"), the rod is always tangential to the circular orbit of its centre; in the second case ("float"), the rod is always perpendicular to the plane of the circular orbit; and in the third case ("spoke"), the rod is always along the radius of the circular orbit. These regular solutions for the motion of the rod were indicated previously. In the present paper, the stability of these regular solutions in Lyapunov's sense is investigated, i.e. a solution is given of the problem of the possibility of prolonged conservation of motion close to one of the regular solutions. The problem is solved first without any further simplifi tions, and then the case is considered where the length of the r is very small in comparison with the radius of the circular orbit its centre, which corresponds to a real case of the motion of an artificial earth satellite. It turns out that in the "arrow" case, regular motion is, in general, unstable, in the "float" case, regular mo is unconditionally unstable, while in the "spoke" case, it may b stable at least in the first approximation.

525

18886 POSSIBLE AERODYNAMIC LIFT AND MOMENT AT THE PERIGEES OF LOW ALTITUDE SATELLITES.

A.F.Charwat.
Phys. of Fluids, Vol. 3, No. 5, 829-30 (Sept.-Oct., 1960).

Considers the transverse momentum balance on asymmetri surfaces under assumptions of single collision theory, such as i applicable to a satellite on an orbit with perigee between 200 an 400 km. It is found that lift is also affected by interactions with the gas and, moreover, that there exists a pitching moment whic would not exist in either free-molecule or Newtonian continuum ow.

A.Boksenberg

525

18887 THE SUDDEN DISCONTINUITY IN THE ORBITAL PERIOD OF SPUTNIK 4 SATELLITE.

B.R.May and D.E.Smith.
Nature (London), Vol. 187, 866-7 (Sept. 3, 1960).

The observed time of this event coincided very closely with the time at which a reported attempt had been made to bring the "space capsule" of the satellite out of orbit.

A.Boksenberg

525

18888 FINAL MONTHS AND DESCENT OF SATELLITE SPUTNIK 3.

B.R.May and D.E.Smith.
Nature (London), Vol. 187, 456-8 (Aug. 6, 1960).

From May 1959 to April 1960 when it descended the mean nodal period-time curve was as expected. Perigee moved from southern apex towards the equator which it reached on Jan. 11, finally reaching 40° N when it descended. Variations in the slope of the curve indicate the constantly changing atmospheric density enco tered at perigee. Some short period irregularities coincided wi prominent geomagnetic storms. Little is known of the final descent.

C.Hazard

525

18889 AN ARTIFICIAL COMET.

I.S.Shklovskii, V.F.Esipov, V.G.Kurt, V.I.Moroz and P.V.Shcheglov.
Astron. Zh., Vol. 36, No. 6, 1073-7 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 6, 986-91 (May-June, 1960).

A method for effecting a substantial increase in the brightness of space rockets, by ejecting a cloud of luminescent gas to form n artificial comet, is described. An account is given of the princip specifications of equipment used in the observation of artificial sodium-cloud comets, and of the results of the artificial comet released on 12 September, 1959. Some of the properties exhibite by a sodium cloud expanding in a vacuum are reported. Future developments in the sodium artificial-cloud technique are considered

525

18890 LONG-FOCUS CAMERAS FOR DETERMINING CO-ORDINATES OF FAINT ARTIFICIAL EARTH SATELLITES.

M.K.Abele.
Astron. Zh., Vol. 37, No. 1, 140-5 (1960). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, 134-9 (July-Aug., 1960).

The use of long-focus cameras of low aperture for photographic tracking of earth satellites is discussed. Two ways of increasing the limiting stellar magnitude, using special plate holders with a moving plate, are described. In the first method a cam of special dimensions is rotated by a synchromous motor to move the plate. Instants of time are recorded on a chronogra The second method utilizes sinusoidal oscillations of the plate, excited by a special electromagnet. Instants of time are recorde by c.r.o. Photographs obtained by both techniques are reproduce, and an evaluation of the precision of the techniques is made.

525 : 537.59

PRELIMINARY RESULTS FROM THE SPACE PROBE
IEER V. See Abstr. 17453

525 : 551.5

EFFECT OF UPPER ATMOSPHERE WIND ON THE ROTATION
ATELLITE 1958δ1. See Abstr. 18483

525 : 551.5

RADIO OBSERVATION OF THE EARTH SATELLITE 1957α.
Abstr. 18488

529 : 539.16

8891 A METHOD OF MEASURING TIME, POSSIBLE IN PRINCIPLE. L.A.Khalfin.

eksper. teor. Fiz., Vol. 39, No. 2(8), 504-6 (Aug., 1960). In sian.

A new method, based on counting the number of disintegrations radioactive source, is suggested. The method differs in princi- from the usual frequency methods and would allow the sible accuracy to be increased sharply. Optimum conditions iire a long lifetime for the radioactive material and a large iber of recorded disintegrations. G.A.Chisnall

529 : 538.56

18892 A MASER TIME AND FREQUENCY STANDARD. A.Ya.Leikin.

ron. Zh., Vol. 36, No. 4, 734-8 (1959). In Russian. English islation in: Soviet Astron.—AJ (New York), Vol. 3, No. 4, 713-16 ı.-Feb., 1960).

The development is described of a molecular time and frequency idard based on an ammonia-beam two-level molecular oscillator, he Kharkov State Institute for Measures and Measuring Instru- its. The method used in tuning the frequency of the molecular illator according to the minimum of the frequency variation as a ction of ammonia pressure in the beam source is described. The resolving power attained in using this tuning method is estimated at $\sim 3 \times 10^{-10}$. The first results obtained in determining the maser frequency are given in terms of a second of Universal Time UT-2, and are based on frequency comparisons (begun on 5 February, 1958 and carried out regularly thereafter) of the maser frequency and a continuously operating quartz-crystal oscillator of the No. 3 frequency standard of the Institute. It is seen that an ammonia-beam maser in unison with a continuously operating quartz clock may be successfully used as a time and frequency standard.

529

18893 FREQUENCY MEASUREMENT OF STANDARD FREQUENCY TRANSMISSIONS. S.N.Kalra.

Canad. J. Phys., Vol. 38, No. 11, 1552 (Nov., 1960).

Gives further results for the month of August 1960. See Abstr. 4915 of 1960. E.G.Knowles

529 : 621.396.91

18894 THE INTERNATIONAL COORDINATION OF TIME SIGNALS AND STANDARD FREQUENCY TRANSMISSIONS. L.Essen.

Nature (London), Vol. 187, 452-3 (Aug. 6, 1960).

This detailed report recapitulates recent developments in methods aimed at precise time-keeping, and describes how coordination of time-signals and standard frequencies (derived from the "atomic clock") transmitted between Gt. Britain and U.S.A. has been achieved. Precise comparison of two-way transatlantic signals is now possible to an accuracy of a few parts in 10^{10}. Present experiments are designed to reveal very small residual errors in propagating the signals, and to demonstrate the feasibility of introducing world-wide time and standard-frequency services without the need to apply subsequent corrections. D.R.Barber

529 : 539.1.07 : 621.374.32

HIGH SPEED COUNTER CHRONOMETER. See Abstr. 17190

PHYSICS

GENERAL

18895 THE TWO ASPECTS OF SCIENCE. G.Thomson.

ence, Vol. 132, 996-1000 (Oct. 14, 1960).

Presidential address to British Association. See Abstr. 16558 1960.

53

18896 USE OF PUNCHED CARDS FOR PERSONAL REFERENCE FILES. R.A.Anderson.

ıer. J. Phys., Vol. 28, No. 8, 694-7 (Nov., 1960).

A brief discussion of the advantages of punched cards for rsonal filing systems is given, followed by a description of the stem used by the author.

53

18897 HALF-LIFE OF A WATER COLUMN AS A LABORATORY EXERCISE IN EXPONENTIAL DECAY.
R.Smithson and E.R.Pinkston.

ıer. J. Phys., Vol. 28, No. 8, 740-2 (Nov., 1960).

A sophomore laboratory exercise is described which uses the w of water from a vertical column through a long horizontal pillary tube as an example of exponential decay. The theory volved is within the comprehension of the students and excellent merical results are obtained.

53

18898 "DEX" OR "ORDER OF MAGNITUDE". J.B.S.Haldane.

ture (London), Vol. 187, 879 (Sept. 3, 1960).

States a case for the adoption of the word "dex" to express a fference of × 10; thus 10^{39} = 39 dex, 10^{1} = 1 dex. Examples of ggested use are given. E.G.Knowles

53

18899 COMMENT ON "INTERRELATIONSHIP OF PHYSICAL QUANTITIES". J.A.Glasel.

mer. J. Phys., Vol. 28, No. 7, 678-9 (Oct., 1960).

See Abstr. 4924 of 1960. It is pointed out that an incorrect derivation of an estimate for the thermal expansion coefficient of a metal is given. The purpose of this note is to show that no easy way of demonstrating to students a method of finding the thermal expansion coefficient is possible. C.F.Barnaby

53

18900 THE UNIVERSAL CONSTANTS OF PHYSICS. J.Palacios.

Nuovo Cimento Suppl., Vol. 6, No. 1, 403-12 (1957). In Spanish.

53

18901 THE BEST POSSIBLE DETERMINATION OF A PHYSICAL CONSTANT WITH THE HELP OF EXPERIMENTAL LAWS. P.Vernotte.

Nuovo Cimento Suppl., Vol. 6, No. 1, 428-9 (1957). In French.

Suppose an experimental law relating a quantity y to a quantity x is of known form, and involves a constant G whose value is desired, together with P other unknown parameters. One can solve for G after measuring y for P + 1 values of x. It is pointed out that if this process is repeated many times, and the results analysed by least squares to give the "best" form for the function y, this does not, in general, lead to the "best" value of G. An alternative process is suggested; the actual values of x at which the measurements take place are determined, by differential calculus, in such a way that errors in the measurements of y have the smallest effect on the calculated value of G. A simple example is given, for which it is stated that the probable error in G is about half that associated with the least squares process.

H.N.V.Temperley

GRAVITATION . RELATIVITY

530.12

18902 THE ABERRATION OF STARS AND THE DEVIATION OF WAVES BY THE MOVEMENT OF THE MEDIUM OF PROPAGATION.

A.Metz.

Ann. Astrophys., Vol. 22, No. 6, 759-64 (1959). In French.

The author shows that the carried-along ether hypothesis is not compatible with the law of aberration as observed. The classical and the relativistic demonstrations of the usual aberration formula are recorded.

530.12 : 523.85

18903 THE ABERRATION OF EXTRAGALACTIC NEBULAE.

O.Heckmann.

Ann. Astrophys., Vol. 23, No. 3, 410-15 (1960).

"Galactic and extragalactic research" Conference (see Abstr. 18832 of 1960). Measurements of differential annual aberration between stars and nebulae with large radial velocities give negative results. The velocity of light is therefore independent of the velocity of the source. The author give also the theory of dilatation due to aberration of the images of nebula in recession.

530.12

18904 METRIC CONNECTION ASSOCIATED WITH A NON-SINGULAR ELECTROMAGNETIC FIELD.

X.Hubaut.

Bull. Acad. Roy. Belgique Cl. Sci., Vol. 46, No. 3, 143-7 (1960). In French.

An extension of some results due to Debever in which the field equations are expressed in terms of the irreducible components of the torsion tensor. Minkowski and conformal connections are considered. R.A.Newing

530.12

18905 FUNDAMENTAL SPINOR REPRESENTATIONS OF THE GENERAL LORENTZ GROUP AND INVERSIONS OF SPACE, TIME AND THE UNIVERSE.

J.Winogradzki.

J. Phys. Radium, Vol. 19, No. 2, 159-65 (Feb., 1958). In French.

Study of the spinor representations of the full Lorentz group which are the most simple for the inversions of space, time or the Universe, and of those which are the most simple for all the three inversions.

530.12

18906 REMARKS CONCERNING THE ARTICLE "FUNDAMENTAL SPINOR REPRESENTATIONS OF THE GENERAL LORENTZ GROUP AND INVERSIONS OF SPACE, TIME AND THE UNIVERSE".

R.Reulos.

J. Phys. Radium, Vol. 19, No. 11, 912 (Nov., 1958). In French.

A disputation concerning the priority of certain ideas involved in the paper cited. (See preceding and following abstracts). R.A.Newing

520.12

18907 A REPLY TO THE REMARKS OF R.REULOS; COMPLEMENTARY REMARK.

J.Winogradzki; R.Reulos.

J. Phys. Radium, Vol. 19, No. 11, 912-13; 913(Nov., 1958). In French.

See preceding abstract.

530.12

18908 THE THIRRING EFFECT IN AN EINSTEIN UNIVERSE.

C.Soergel-Fabricius.

Z. Phys., Vol. 159, No. 5, 541-53 (1960). In German.

Generalization of the classical empty universe calculation (see Abstr. 8476 of 1955), with a discussion of Mach's principle. F.A.E.Pirani

530.12 : 523.11

18909 GRAVITATION AND THE PRINCIPLE OF STATIONARY ACTION.

C.Gilbert.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 4, 367-86 (1960).

A quadratic action principle is used to derived equations for pure gravitational fields. Matter is described by solutions of the field equations which are free from singularities and have a non-vanishing action density. A cosmological model is determined by this type of "matter-field", but the discrete nature of matter in the universe is taken into account by replacing parts of the matter-field by mass particles of equal action and by free-space solutions of the field equations. Inertial systems are defined by the matt- field and the inertial mass of a particle is defined from the form of its action. The inertial mass is not constant, but varies as (epoch). The properties of the model are shown to agree with results fou by Dirac for a cosmological model. Also the equations of motic of free particles in a local field are shown to be approximately the same as the Newtonian equations of motion under an inverse squ law of attraction with the gravitational power of matter proport to $(\text{epoch})^{-1/2}$. For small angular velocities there are paths whi are equiangular spirals, and it is shown how these paths can giv rise to spiral arms in a galaxy. A brief discussion is given of relation of the model to the Einstein—de Sitter universe, and of certain resemblances to Milne's kinematic model.

5

18910 NOTE ON POSITIVE-DEFINITENESS OF THE ENE OF THE GRAVITATIONAL FIELD.

R.Arnowitt, S.Deser and C.W.Misner.

Ann. Phys. (New York), Vol. 11, No. 1, 116-21 (Sept., 1960).

The energy of the gravitational field is shown to be positive definite for the case where initially (a) the spatial metric g_{ij} ca be made isotropic and (b) the second fundamental form

$$K_{ij} \equiv -(-g^{00})^{1/2}\Gamma^{0}{}_{ij}$$

(which is essentially $\partial g_{ij}/\partial t$) is arbitrary apart from the coordi condition $K \equiv K_{ij}{}^{3}g^{ij} = 0$ defining the initial t = const. surface. Physically, this situation corresponds to no wave excitations ini in g_{ij}, but arbitrary ones in K_{ij}. More precisely, the two canonical coordinates of the field are initially zero, while their conjugate momenta are arbitrary. The total energy of the system is also positive when sources with positive energies are coupled to the gravitational field. Some aspects of the general problem (when g_{ij} is also arbitrary initially) are discussed.

53

18911 GRAVITATIONAL RED SHIFT OF HYDROGEN 21-c RADIATION AS A METHOD TO MEASURE GALACT GRAVITATIONAL POTENTIAL.

L.F.Landovitz and L.Marshall

Nature (London), Vol. 187, 223-4 (July 16, 1960).

530.12 : 52

18912 THE POSSIBILITY OF DETECTING A GRAVITATIONAL RED SHIFT IN 21 cm RADIATION FROM THE GALAXY.

F.J.Kerr.

Nature (London), Vol. 188, 216-17 (Oct. 15, 1960).

The red shift is proportional to the difference in potential between the point of emission and the earth's surface and would g shifts corresponding to Doppler velocities of the order of +0.7 km Landovitz and Marshall suggested that it might be possible to isolate this shift from larger shifts, arising from differential rotation of the Galaxy, by searching for asymmetries over the galac plane. It is here suggested that a more detailed knowledge would required of galactic motion and structure, and that the asymmetr might be masked by similar asymmetries arising from an outwar solar motion away from the galactic centre. R.A.New

53

18913 THE DEFLECTION OF LIGHT BY THE GRAVITATIONAL FIELD OF THE SUN.

A.A.Mikhailov.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 6, 593-608 (1959).

A critical review of observations which have been carried o to try to detect the effect and to discriminate between Newton's a Einstein's values for the constant of proportionality in the assum hyperbolic law. Using the same least squares method for the observations of 1919, 1922, 1929, 1936, 1947 and 1952, the consta is recomputed. The sum of squares of residuals for each observ is found in three cases: (a) using the recomputed value; (b) using Einstein's predicted value (1.75"); (c) assuming that the observed deflections depend linearly on the distance from the Sun's centre. The best overall value for the constant is 2.0". It seems that the observations are not good enough to decide either the form of the law or the value of the constant. G.A.Chis

53

18914 SINGULARITIES OF COSMOLOGICAL SOLUTIONS O THE GRAVITATIONAL EQUATIONS. I.

E.M.Lifshitz and I.M.Khalatnikov.

Zh. eksper. teor. Fiz., Vol. 59, No. 1(7), 149-57 (July, 1960). In Russian.

The problem of the investigation of the general properties of logical solutions of the gravitational equations near a time arity is stated. A particular class of solutions is found which eneralization of the familiar solution corresponding to a geneous and isotropic world. A general solution is derived for se of a centrally symmetric distribution of matter and its sion to a broader class of solutions is presented.

530.12

·915 THE VISUAL APPEARANCE OF RAPIDLY MOVING OBJECTS. V.F.Weisskopf.

. Today, Vol. 13, No. 9, 24-7 (Sept., 1960).

very clear popular account of the recently noticed result that, ugh an object is described as contracted in a coordinate-system respect to which it is moving, it is not seen as contracted by an ver at rest in the coordinate-system. This property of light is esting because of a loose usage of language which has been non in the past in expounding relativity. C.W.Kilmister

530.12

916 LANGEVIN'S PARADOX OF THE TRAVELLER AND SPECIAL RELATIVITY. G.Darrieus.

Acad. Sci. (Paris), Vol. 251, No. 3, 309-13 (July 18, 1960). rench.

Simple (almost equation-free) exposition of the twin paradox its resolution, with a numerical illustration. F.A.E.Pirani

530.12 : 539.14

8917 SOME RECENT EXPERIMENTAL TESTS OF THE "CLOCK PARADOX". C.W.Sherwin.

s. Rev., Vol. 120, No. 1, 17-21 (Oct. 1, 1960).

Recent experiments by Pound and Rebka on the temperature endence of the Mössbauer effect in Fe^{57}, and by Hay, Schiffer, nshaw, and Egelstaff using an Fe^{57} absorber on a rotating drum, shown to provide the first direct experimental verification of time-keeping properties of accelerated clocks such as occur he classic "clock paradox" of relativity. In the experiment by nd and Rebka, the thermal vibrations of the lattice impart r.m.s. ocities of about $10^{-6}c$, and nearly continuous, randomly-oriented elerations of the order of $10^{16}g$ to both the source and the ab- ber nuclei. In the experiment by Hay et al. the acceleration of absorber was $6 \times 10^{4}g$. The photon provides continuous com- ication of time data between the two nuclei for the duration of the rney" (the emission time of the quantum). In each case the erved fractional frequency shift $\Delta f/f_0$ which occurs between the rce and the absorber is found to be $-v_s^2/2c^2 + v_a^2/2c^2$, where nd v_a are the r.m.s. velocities of the source and the absorber lei, respectively. These results are in quantitative agreement the generally accepted calculations for the "clock paradox", in ch two clocks pursue independent paths (at least one of which lves accelerations) in a common inertial frame, but are com- ed at two or more points where they coincide in space and time. temperature-dependent experiments also demonstrate that elerations of the order of $10^{16}g$, arising from lattice vibrations, duce no intrinsic frequency shift in Fe^{57} nuclei to an accuracy eeding 1 part in 10^{13}.

530.12 : 539.14

8918 FIRST-ORDER TERRESTRIAL ETHER DRIFT EXPERIMENT USING THE MÖSSBAUER RADIATION.

uderfer.

s. Rev. Letters, Vol. 5, No. 5, 191-2 (Sept. 1, 1960).

Radiation travelling from the centre to the periphery of a olving turntable moving through the aether would fluctuate in fre- ncy. The author estimates that at 1800 r.p.m., with path length m, and "least count" sensitivity 3 parts in 10^{16} for the Mössbauer ation, an aether drift of 1.5 m sec^{-1} should be detectable. F.A.E.Pirani

530.12

8919 APPLICATION OF RELATIVISTIC INVARIANT GROUPS TO EXTENDED PARTICLE MODELS IN SPECIAL LATIVITY. P.Hillion and J.P.Vigier.

.Acad. Sci. (Paris), Vol. 250, No. 25, 4117-19 (June 20, 1960). French.

It is maintained that all properties of a point-particle would be en by a theory invariant with respect to the general Lorentz up GL_4, whereas for particle models of finite spatial extension, riance with respect to three groups is involved: an internal up defining the structure of the particle, the special Lorentz up SL_4 with respect to which the equations of motion are invariant, and the general group GL_4 of coordinate transformations. Application to the authors' rotating fluid droplet model is considered. R.A.Newing

530.12

18920 ON THE QUANTIZATION OF THE FREE ELECTROMAGNETIC FIELD IN SPECIAL RELATIVITY.

A. Capella.

C.R. Acad. Sci. (Paris), Vol. 251, 636-8 (Aug. 1, 1960). In French.

The energy-momentum 4-vector P^{μ} for the vacuum field is expressed in terms of annihilation and creation operators, the energy component P^0 being positive definite independently of the Lorentz condition. Photon spin is parallel or antiparallel to the direction of propagation. R.A.Newing

530.12

18921 ON ANALYTIC PARTICLE DYNAMICS IN SPECIAL RELATIVITY. Pham Mau Quan.

C.R.Acad. Sci. (Paris), Vol. 251, No. 5, 639-41 (Aug. 1, 1960). In French.

Briefly develops the formalism, including Lagrangian, Hamiltonian, and Hamilton–Jacobi, for motion of a particle in a scalar field (compare Abstr. 897 of 1956). F.A.E.Pirani

530.12 : 535.1

18922 A DIRECT EXPERIMENTAL PROOF OF THE SECOND POSTULATE IN THE SPECIAL THEORY OF RELATIVITY (COMMENT ON DINGLE'S NOTE). A.M.Bonch-Bruevich.

Optika i Spektrosk., Vol. 9, No. 1, 134-5 (July, 1960). In Russian.

Commenting on Dingle's note (Abstr. 10563 of 1959) the author summarizes his own experiments [Abstr. 209, 1041 of 1957; Optika i Spektrosk, Vol. 2, 141 (1957)] which proved that the velocity of light is independent of the velocity of a light source. This was done by comparing the times, t_1 and t_2, necessary to cover a distance of 200 m by light signals from two moving sources which were the equatorial limbs of the sun. More than 1700 measurements yielded

$$\Delta t = t_2 - t_1 = (1.4 \pm 5.1) \times 10^{-12}\,\mathrm{sec}$$

(classical theory predicts $\Delta t = 75 \times 10^{-12}$ sec). These results indicated that the special relativity theory is 10^{45} times more likely to be correct than the classical laws. A.Tybulewicz

530.12

18923 ON RELATIVISTIC ROCKET DYNAMICS. N.S.Kalitzin and I.P.Nedjalkov.

C.R. Acad. Bulg. Sci., Vol. 13, No. 3, 273-5 (May-June, 1960). In German.

The first author's previous work (Abstr. 6564, 11793 of 1959) is generalized to the case of a rocket with relativistic velocity in a Minkowski inertial frame, as well as relativistic exhaust velocity. F.A.E.Pirani

530.12 : 535.1

18924 THE PATHS OF RAYS OF LIGHT IN GENERAL RELATIVITY. L.P.Eisenhart.

Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 8, 1093-7 (Aug., 1960).

From the fact that a possible tangent vector λ^i for a null geodesic is one such that

$$\lambda_{i;j} = a\lambda_i\lambda_j + b\lambda_i\mu_j + c\lambda_j\mu_i,$$

where $\lambda^i\mu_i = 0$, a solution is found for null geodesics in a space-time of constant density. C.W.Kilmister

530.12

·18925 GENERAL LAGRANGIAN AND CANONICAL FORMALISM DESCRIBING THE RELATIVISTIC MOTION OF A FREE ROTATING PARTICLE. F.Halbwachs.

Acta phys. Polon., Vol. 19, No. 1, 93-114 (1960).

A very general formulation of the idea of a relativistic rotating particle in Lagrangian form is carried out, with one eye on the results of relativistic hydrodynamics with rotation. The angular momentum, for example, is described by a skew tensor $S_{\mu\nu}$ such that $S_{\mu\nu} = \epsilon_{\mu\nu\alpha\beta}\, s^{\alpha}v^{\beta} + (v_{\mu}t_{\nu} - v_{\nu}t_{\mu})$ where v^{μ} is the four-velocity and s^{α}, t_{α} are 2 vectors orthogonal to it. Special choices of Lagrangian give already known theories. C.W.Kilmister

530.12

18926 FLUCTUATIONS OF SPACE-TIME METRIC. D.I.Blohinčev.

Nuovo Cimento, Vol. 16, No. 2, 382-7 (April 16, 1960).

The energy-momentum tensor is expressed as the sum of a term corresponding to the global motion of matter and a term arising from a turbulent motion characterized by a small length scale and short time period. An estimate is made of metric fluctuations both for macrophysical and for microphysical fields. In the latter case it is found that fluctuations arising from the oscillations of a scalar field become important only throughout small regions whose characteristic dimensions are of the order of 10^{-32} cm. R.A.Newing

530.12

18927 INVARIANTS OF GENERAL RELATIVITY.
I. CANONICAL FORMALISM. A.Peres.

Nuovo Cimento, Vol. 18, No. 1, 32-5 (Oct. 1, 1960).

It is shown that, if the Einstein equations are satisfied, the gravitational field invariants must be functions of the Dirac canonical variables only. It is further shown that the non-canonical variables $g_{0\mu}$ can be explicitly expressed as functions of the canonical ones (and their first time derivatives) and therefore can be eliminated from the Einstein equations.

530.12

18928 INVARIANTS OF GENERAL RELATIVITY.
II. CLASSIFICATION OF SPACES. A.Peres.

Nuovo Cimento, Vol. 18, No. 1, 36-47 (Oct. 1, 1960).

Petrov's classification of pure gravitational fields is generalized to the case where matter is present. It is shown how the Petrov invariants can be computed directly, i.e. without the intermediate stage of quasi-Galilean coordinates (or tetrads, or spinors) that was required in previous works. It is further shown that, if some of the invariants of Geheniau and Debever vanish, it is sometimes possible to find new algebraic invariants of the Riemann tensor, which are independent of those of Geheniau and Debever. This fact is especially interesting when all the Geheniau–Debever invariants vanish, as is shown by an example.

530.12

18929 MEASUREMENT OF THE CURVATURE IN A TWO-DIMENSIONAL UNIVERSE. E.P.Wigner.

Phys. Rev., Vol. 120, No. 2, 643 (Oct. 15, 1960).

The usual definition of the curvature of space involves concepts, such as the measurement of the metric tensor or parallel displacement, which have no direct physical counterpart. The question of obtaining the curvature of a two-dimensional space by means of measurements which are possible, at least in principle, is reviewed and a formula given before is corrected and generalized.

530.12

18930 REMARKS ON SCHRÖDINGER'S MODEL OF DE SITTER SPACE. W.Rindler.

Phys. Rev., Vol. 120, No. 3, 1041-4 (Nov. 1, 1960).

Schrödinger in his book "Expanding Universes" [Cambridge: Cambridge University Press (1956) Chapter I] developed a "reduced model" of de Sitter space-time consisting of a certain hyperboloid of one sheet. He showed, inter alia, that timelike sections of the hyperboloid by planes through its centre correspond to free paths in de Sitter space-time. The main purpose of the present note is to show that timelike sections by arbitrary planes correspond to paths of uniformly accelerated particles, and then to deduce some simple properties of such paths. What is here called Schrödinger's model seems to have been first proposed by Weyl (Abstr. 1774 of 1923) and was further discussed by Robertson (Abstr. 2080 of 1928; 2233 of 1933). Schrödinger's discussion, however, is the fullest.

530.12 : 538.3

18931 PURE RADIATION IN THE PRESENCE OF ELECTROMAGNETIC INDUCTION. C.Latrémolière.

C.R. Acad. Sci. (Paris), Vol. 251, No. 3, 338-9 (July 18, 1960). In French.

Lichnerowicz's definition of pure electromagnetic radiation in free space (see, for example, Abstr. 3674 of 1958) is generalized to the case of a continuous medium in which the two electromagnetic tensors are related linearly. F.A.E.Pirani

530.12

18932 RADIATION: GRAVITATIONAL AND ELECTROMAGNETIC. P.C.Vaidya and I.M.Pandya.

Curr. Sci., Vol. 29, No. 7, 268 (July, 1960).

The metric $ds^2 = -dy^2 - dz^2 + [1 + f]dt^2 + 2dxdt$, $f = f(y,z,t)$ may be associated with an electromagnetic field (Einstein—Maxwell theory) if $f_{yyz} + f_{zzz} = 0$, and then describes a flow of electromagnetic radiation. If the e.m. field is switched off the resultan metric ($f_{yy} + f_{zz} = 0$) gives cylindrical waves. C.W.Kilmi

53.12

18933 A MODIFIED VERSION OF EINSTEIN'S UNIFIED FIELD THEORY. J.Lévy.

J.Phys. Radium, Vol. 20, No. 8-9, 747-50 (Aug.-Sept., 1959). In Fren

To avoid restrictions and difficulties encountered in classic theories of Einstein's unified field, it is necessary to introduce into a Lagrangian formalism, a tensor built as $\Gamma_\mu \Gamma_\nu$ from the torsion vector. Field equations in two equivalent sets are dedu and a current with the ability to give non-vanishing equations of motion is pointed out.

5302

18934 INITIAL VALUE PROBLEM OF THE EINSTEIN—MAXWELL FIELD. L.Witten.

Phys. Rev., Vol. 120, No. 2, 635-40 (Oct. 15, 1960).

On an initial hypersurface, $x^0 = 0$, in the presence of gravita tion and source-free electromagnetism one can specify the metri tensor, $g_{\mu\nu}$, and its partial derivatives, $g_{\mu\nu,0}$, as well as the ele magnetic tensor, $f_{\mu\nu}$. These quantities must be specified so tha the initial hypersurface two of Maxwell's equations are satisfied and so that the components $R_\alpha{}^0$ of the Ricci tensor are proportio to the components $T_\alpha{}^0$ of the electromagnetic energy-momentum tensor. It is sometimes possible to specify a different electromagnetic tensor on the initial hypersurface which together with t old metric and Ricci tensors will describe a properly set initial value problem such that the geometry in advance of the initial hypersurface is different for the different electromagnetic fields. Thus, the Ricci tensor on the initial hypersurface does not always uniquely describe the geometry off the hypersurface in the Einste Maxwell theory. The conditions when this nonuniqueness exists a explicitly derived. An initial value problem could be set by speci- ing $g_{\mu\nu}$ and $g_{\mu\nu,0}$ on the initial hypersurface and deriving an appr- priate $f_{\mu\nu}$; however, $g_{\mu\nu}$ and $g_{\mu\nu,0}$ cannot be arbitrarily specifie but are subject to one rather complicated constraint condition on the hypersurface.

5302

18935 GRAVITATIONAL—ELECTROMAGNETIC COUPLING AND THE CLASSICAL SELF-ENERGY PROBLEM.

R.Arnowitt, S.Deser and C.W.Misner.

Phys. Rev., Vol. 120, No. 1, 313-20 (Oct. 1, 1960).

The gravitational effect on the classical Coulomb self-energy a point charge is calculated rigorously. It is shown that the total mass then becomes finite (although still quite large), and that it depends only on the charge and not on the bare mechanical mass. Thus, a particle acquires mass only when it has non-gravitational interactions with fields of nonzero range. In order to treat this problem, it is necessary to extend the canonical formalism, previously obtained for the free gravitational field, to include couplin with the Maxwell field and the point charge system. It is shown th the canonical variables of the gravitational field are unaltered wh those of the matter system are natural generalizations of their fla space forms. The determination of the total energy of a state can still be made from knowledge of the spatial metric at a given time The self-mass of a particle is then the total energy of a pure one- particle state, i.e., a state containing no excitations of the canonic variables of the Maxwell or Einstein fields. Solutions correspond to pure particle states of two like charges are also obtained, and their energy is shown consistent with the one-particle results.

530.

18936 INTERIOR SCHWARZSCHILD SOLUTIONS AND INTERPRETATION OF SOURCE TERMS.

R.Arnowitt, S.Deser and C.W.Misner.

Phys. Rev., Vol. 120, No. 1, 321-4 (Oct. 1, 1960).

The solutions of the Einstein field equations, previously used in deriving the self-energy of a point charge, are shown to be nonsingular in a canonical frame, except at the position of the particl A distribution of "dust" of finite extension is examined as the mod whose limit is the point particle. The standard "proper rest-mas density" is related to the bare rest-mass density. The lack of singularity of the initial metric $g_{\mu\nu}$ is in contrast to the Schwarzschild type singularity of standard coordinate systems. The pres solutions for the extended source are nonstatic in general, corresponding to the fact that a charged dust is not generally in equilibri However, the solutions become static in the point limit for all valu of the bare-source parameters. Similarly, the self-stresses vanis for the point particle. Thus, a classical point electron is stable, avitational interaction cancelling the electrostatic self-force, ut the need for any extraneous "cohesive" forces.

530.12 : 539.11

937 INTERPRETATION OF ELECTRODYNAMICS AND BARYON THEORY WITHIN A SIX DIMENSIONAL IFOLD. J.Rayski.

ear Phys., Vol. 17, No. 2, 289-316 (June (3), 1960).

Assuming a six-dimensional world with a singular metric, a ry theory of gravitation and electromagnetic field is formu- . Electric charge is interpreted as angular momentum in the and sixth dimensions. Sommerfeld's constant is closely ected with the degree of singularity of the metric tensor. ric spin and its connection with the electric charge as well e pseudo-scalar character of pions are easily interpretable. hypothesis of a six-dimensional world enables a systematiza- of elementary particles. In particular, it is shown that the on family fits quite naturally into the six-dimensional frame- .

530.12

938 OSCILLATORY CHARACTER OF REISSNER—NORDSTRÖM METRIC FOR AN IDEAL CHARGED WORM- E. J.C.Graves and D.R.Brill.

. Rev., Vol. 120, No. 4, 1507-13 (Nov. 15, 1960).

A transformation is presented to remove coordinate ("pseudo") ularities from metrics of a certain class, a special case of h is the transformation of Kruskal, extending the Schwarzs- metric beyond its pseudosingularity. The transformation is ied to the Reissner—Nordström metric, which describes a entration of charge and mass in general relativity. On an al surface this metric shows the same general behaviour as the arzschild metric, describing a "wormhole," or bridge, between asymptotically flat spaces, but with electric flux flowing through vormhole. It is found that the region of minimum radius, the alled "throat" of the wormhole, begins to contract, but reaches nimum and re-expands after a finite proper time, rather than ning off as in the Schwarzschild—Kruskal case: the radius of hroat pulsates periodically in time, "cushioned" by Maxwell sure of the electric field through the throat. The motion of ged particles in this metric is investigated, and it is shown no particle can hit the geometric singularity at $r = 0$; (1) quite neral, provided only that the mass of the test particle exceeds alue associated in general relativity with its charge, and (2) rticular when the test particle has no charge at all, but (3) collisions are not avoided when the throat itself is not endowed any electric flux.

530.12

939 AXIOMATICS OF METRIC SPIN TENSORS IN PROJECTIVE RELATIVITY THEORY. E.Schmutzer.

aturforsch., Vol. 15a, No. 9, 831-5 (Sept., 1960). In German.

Generally covariant spinor algebra in 5-space is developed assumptions of hermiticity and of product structure for the mensional) connecting quantities $\sigma_{\mu\dot{A}B}$. Projection into space- yields results agreeing with the author's earlier work (Abstr. 4 of 1960). F.A.E.Pirani

QUANTUM THEORY

(Applications of quantum theory to elementary particles and nuclei are included under Nuclear Field Theory)

530.14

8940 QUANTUM KINEMATICS AND GEOMETRY. M.Schönberg.

o Cimento Suppl., Vol. 6, No. 1, 356-80 (1957).

530.14

3941 SOME REMARKS ON THE QUANTUM MECHANICAL CONCEPT OF PHYSICAL QUANTITIES. F.Jeszenszky.

. phys. Hungar., Vol. 11, No. 3, 217-24 (1960). In German.

The general conditions under which it is possible to give ultaneously the value of two canonically conjugate variables are ied. Consideration of the measurement of these quantities eals an essential distinction between the behaviour of a quantum hanical system and the results of measurements upon it. E.J.Squires

530.14

18942 THE GROUP-THEORETICAL FOUNDATIONS OF QUANTUM MECHANICS. I.

P.G.O.Freund and I.Hegedüs.

Acta phys. Hungar., Vol. 11, No. 3, 285-9 (1960). In German.

General criteria for forming wave equations are derived and it is shown that the wave equations are maximal i.e. the most general possible homogeneous linear differential equations invariant under a given group of transformations. E.J.Squires

530.14

18943 THE GROUP THEORETICAL FOUNDATIONS OF QUANTUM MECHANICS. II.

P.G.O.Freund and I.Hegedüs.

Acta phys. Hungar., Vol. 11, No. 3, 291-4 (1960). In German.

It is shown how the requirement of invariance with respect to a given group of transformations leads to the operator character of physical quantities, and also to the uncertainty principle. E.J.Squires

530.14

18944 REMARKS ON A METHOD OF SUMMATION IN PERTURBATION THEORY. M.Demeur and C.Joachain.

Bull. Acad. Roy. Belgique Cl. Sci., Vol. 46, No. 4, 225-32 (1960). In French.

The sum rule of Dalgarno and Lewis (Abstr. 3131 of 1956) is extended to the case of degenerate states. J.Hawgood

530.14

18945 THE GEOMETRICAL INTERPRETATION OF RAYLEIGH'S PRINCIPLE AND SCHWINGER'S VARIATIONAL PRINCIPLE. Ll.G.Chambers.

Bul. Inst. Politeh, Iasi, Vol. 5(IX), No. 1-2, 151-60 (1959).

It is shown that Schwinger's principle is a degenerate form of Rayleigh's principle with one eigenvalue positive and finite and all others zero. The geometrical interpretation is in terms of the properties of the hyperquadrics involved. W.A.Hepner

530.14

18946 GEOMETRIC INTRODUCTION OF THE NOTION OF THE CLIFFORD ALGEBRA IN THE THEORY OF SPINORS.

P.Cavailles.

Cahiers de Phys., Vol. 14, 81-98 (March, 1960). In French.

Explains the principal properties of the Clifford algebras (e.g. that generated by the Dirac matrices) used in physics. A geometrical method is used which is intended to be clear to the physicist and also to demonstrate the fundamental origin of these properties. J.Goldstone

530.14

18947 ON TEMPERATURE QUANTUM GREEN'S FUNCTIONS. Sh.M.Kogan.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1186-96 (June, 1960). In Russian.

Considers the generalization of the quantum Green function method to systems at an arbitrary temperature. The calculation is applied in particular to a system of Fermi particles with an electromagnetic interaction. An expression is derived for the energy momentum relation in semiconductors and it is shown that many-body effects reduce the effective mass. M.G.Priestley

530.14

18948 ON THE THEORY OF THERMAL GREEN FUNCTIONS. V.L.Bonch-Bruevich.

Dokl. Akad. Nauk SSSR, Vol. 126, No. 3, 539-42 (May 21, 1959). In Russian. English translation in: Soviet Physics—Doklady (New York), Vol. 4, No. 3, 596-600 (Dec., 1959).

Time and temperature-dependent Green functions are defined for a many-body system and used to derive correlation functions and the quasi-particle excitations. The method is used to calculate the momentum distribution of a non-degenerate electron gas. The attenuation of the excitations is also given. J.Goldstone

530.14

18949 ON THERMAL QUANTUM GREEN FUNCTIONS. Sh.M.Kogan.

Dokl. Akad. Nauk SSSR, Vol. 126, No. 5, 546-9 (May 21, 1959). In Russian. English translation in: Soviet Physics—Doklady (New York), Vol. 4, No. 3, 604-8 (Dec., 1959).

Quantum Green functions which depend on both time and temperature are defined for a many-body system as averages of time-ordered products of operators in a canonical ensemble. These are

used to discuss quasi-particles. The functional differential equations for the functions are written down and discussed briefly.
J.Goldstone

530.14

18950 FURTHER DISCUSSION OF POSSIBLE EXPERIMENTAL TESTS FOR THE PARADOX OF EINSTEIN, PODOLSKY AND ROSEN. D.Bohm and Y.Aharonov.

Nuovo Cimento, Vol. 17, No. 6, 964-76 (Sept. 16, 1960).

In a previous article (Abstr. 5614 of 1958) the authors suggested the experiment of Wu—Shaknov on the annihilation radiation of positronium as a test for the paradox of Einstein, Podolsky and Rosen. In this article, they answer certain criticisms of their conclusions, raised by Peres and Singer (Abstr. 14517 of 1960). These criticisms are shown to be erroneous, being based on a incorrect interpretation of the polarization of electromagnetic radiation in the quantum domain.

530.14

18951 MEASUREMENT OF QUANTUM MECHANICAL OPERATORS. H.Araki and M.M.Yanase.

Phys. Rev., Vol. 120, No. 2, 622-6 (Oct. 15, 1960).

The limitation on the measurement of an operator imposed by the presence of a conservation law is studied. It is shown that an operator which does not commute with a conserved (additive) quantity cannot be measured exactly (in the sense of von Neumann). It is also shown for a simple case that an approximate measurement of such an operator is possible to any desired accuracy.

530.14

18952 CONFIGURATIONS IN QUANTUM MECHANICS. E.M.Bruins.

Physica, Vol. 25, No. 10, 905-8 (Oct., 1959).

The classification of quantum mechanical problems corresponds to the algebraic theory of line complexes in three-dimensional space. It is pointed out that this is often overlooked and that the normal procedure at present is equivalent to working in point geometry. The advantages gained from the use of line geometry is exemplified by a result which can be obtained in a few lines using this method, but which otherwise requires much laborious computation. This calculation is given, not in its shortest form, but using homogeneous coordinates for simplicity of demonstration.
H.Morrison

530.14

18953 AN ANALYSIS OF INFRARED DIVERGENCES. E.R.Caianiello and S.Okubo.

Nuovo Cimento, Vol. 17, No. 3, 355-64 (Aug. 1, 1960).

A concise and rigorous treatment is given of the infrared divergences of quantum electrodynamics, by using a technique previously developed in connection with ultraviolet renormalization. The result is essentially equivalent to an extension of the classical Bloch—Nordsieck formula, and is independent of perturbative methods.

530.14

18954 QUANTUM ELECTRODYNAMICS IN AN EXPANDING UNIVERSE. F.L.Scarf.

Nuovo Cimento, Vol. 17, No. 3, 375-83 (Aug. 1, 1960).

The equations of quantum electrodynamics are investigated in an expanding universe characterized by a de Sitter metric. It is assumed that the expansion occurs on a microscopic level and that $\hbar$, the bare electron mass and the bare charge are all constant. For a particular coordinate system the operators may be expressed in terms of coupled flat-space fields which have m replaced by mR(t). The equivalent quantized field problem is soluble using standard perturbation theory with modified commutators and Green's functions. As a first approximation, adiabatic changes caused by the expansion are evaluated by making the replacement $m \rightarrow mR$ in all final formulae. Renormalization effects are examined using asymptotic expressions which contain ultraviolet cut-offs. Assuming that the cutoff procedures are meaningful and are related to the structure of the physical electron, it is noted that the renormalized mass and charge could vary with time for a particular kind of cut-off process.

530.14

18955 QUANTUM THEORY IN PSEUDO-HILBERT SPACE. II. G.Konisi and T.Ogimoto.

Progr. theor. Phys., Vol. 21, No. 5, 727-30 (May, 1959).

In Pt I (Abstr. 14516 of 1960) one could remove the difficulty of the Lorentz non-invariance of Gupta's old theory (Abstr. 6997 of 1950) in quantum electrodynamics in the case of the free field. The same problem is investigated in the case where the interaction i present.

530

18956 COLLECTIVE OSCILLATIONS AND GIANT DENSITY FLUCTUATIONS. R.Brout.

Phys. Rev. Letters, Vol. 5, No. 5, 193-5 (Sept. 1, 1960).

It is shown that the existence of exponentially growing soluti of the equations of the random phase approximation is indicative the existence of stable solutions of the Hartree self-consistent fi equations that have a built-in density ripple. A possible applicat of this idea to the freezing of He^3 is discussed.
D.J.Thoul

530

18957 THE INDEFINITE METRIC IN THE SPACE OF STAT AND THE PROBABILITY INTERPRETATION. I.

S.Schlieder.

Z. Naturforsch., Vol. 15a, No. 5-6, 448-60 (May-June, 1960). In German.

The paper shows the possibility of making consistent use of an indefinite metric in the space of states and of the probability interpretation of quantum mechanics. Bilinear forms are constr-ted which are invariant under the transformations of symmetry groups. The construction of the fundamental metric tensor for th various types of representations is exemplified for the case of the inhomogeneous Lorentz group. The results are also applicab for other groups. The representations of the finite and compact group are however normal. In these cases the use of an indefinit metric does not add to theory of representations.

5304

18958 THE INDEFINITE METRIC IN THE SPACE OF STAT AND THE PROBABILITY INTERPRETATION. II.

S.Schlieder.

Z. Naturforsch., Vol. 15a, No. 5-6, 460-7 (May-June, 1960). In German.

Following the work of Pt I (see preceding abstract) further c-ditions are specified for the "space of physical states". They are sufficient in the first instance for the probability interpretation fo elements of one coherent sector.

53

18959 THE INDEFINITE METRIC IN THE SPACE OF STAT AND THE PROBABILITY INTERPRETATION. III.

S.Schlieder.

Z. Naturforsch., Vol. 15a, No. 7, 555-65 (July, 1960). In German.

Continuing the work of Pt I and II, the subject of the space of states as a whole is discussed. The existence of superselection rules allows one to give up the fundamental tensors formerly intr-duced as identity matrices in the subspace of the physical states. The mathematical form, in which symmetry groups appear is sho by an example. Finally a possible generalization for the dual element of an element is given.

530

18960 ON THE INTERPRETATION OF QUANTUM MECHAN W.Weidlich.

Z. Naturforsch., Vol. 15a, No. 8, 651-4 (Aug., 1960).

This paper discusses the connection between a possible parameter space, in which it is possible to give a deterministic descri tion of a physical system, and the Hilbert space of conventional quantum mechanics.
E.J.Squi

530.

18961 THE MANY-SIDEDNESS OF "UNAWARE" (INFORMATIONSFREMDER) STATES IN QUANTUM THEORY. F.Schlögl.

Z. Phys., Vol. 159, No. 4, 411-27 (1960). In German.

The fundamental tenets of quantum theory are examined with particular reference to the ideas of duality and complementarity a the reaction between an observer and the observed.
S.C.Du

STATISTICAL MECHANICS
TRANSFER PROCESSES

530.16

8962 **DEVIATIONS FROM EQUIPARTITION OF ENERGY WITH NONQUADRATIC HAMILTONIAN.** A.Peterlin.
er. J. Phys., Vol. 28, No. 8, 716-18 (Nov., 1960).

If the Hamiltonian contains nonquadratic terms, the energy
ribution per particle and degree of freedom deviates from $\frac{1}{2}$kT
ssical approximation). A very simple case which can be easily
ted is that of a particle in a sinusoidal potential field. Energy
energy, and molar heat are calculated as an example of the
lting deviations from equipartition.

530.16

8963 **TIME INDEPENDENT PERTURBATION SOLUTION OF THE LIOUVILLE EQUATION.** P.Resibois and B.Leaf.
. Acad. Roy. Belgique Cl. Sci., Vol. 46, No. 3, 148-56 (1960).

The Liouville equation of classical mechanics is solved by a
od analogous to the time-independent perturbation technique of
tum mechanics. This leads to an expansion in powers of the
meter describing the coupling between elementary systems.
n example, the "master equation" is derived for the weakly
led homogeneous gas. H.N.V.Temperley

530.16

3964 **STATISTICAL MECHANICS OF TRANSPORT PROCESSES. XIV. LINEAR RELATIONS IN MULTI-MPONENT SYSTEMS.** J.G.Kirkwood and D.D.Fitts.
hem. Phys., Vol. 33, No. 5, 1317-24 (Nov., 1960).

For Pt. XIII see Abstr. 11865 of 1959. A classical
tment of the time dependence of a phase distribution
tion for a system near equilibrium is presented. The
-order function plus a perturbation term and is used to obtain
diffusion and heat fluxes by averaging the appropriate dynami-
variables. When only terms linear in the gradients of the local
perature, the chemical potentials, and the velocity of the local
res of mass are retained, the usual linear relations result and
licit expressions for the phenomenological coefficients are
ined. These expressions agree with the results of Mori and
reen and are shown to obey the Onsager reciprocal relations.

530.16

8965 **THE STATISTICAL THERMODYNAMICS OF A GAS WITH LONG AND SHORT-RANGE FORCES.** S.F.Edwards.
. Mag. (Eighth Ser.), Vol. 4, 1171-82 (Oct., 1959).

If a gas has long-range Coulomb interactions and short-range
raction, e.g. hard core repulsions, three lengths enter the problem;
radius of the repulsive core, d, the mean interparticle distance,
nd λ_D the Debye—Huckel radius, $(8\pi Ne^2/VkT)^{-1/2}$. This paper
sents a method of obtaining the equation of state when, in the first
ance $\lambda_D \gg r_0 \gg d$, which enables one to obtain higher-order
ns in a simple,way, and these are calculated. In order to relax
condition $\lambda_D \gg r_0$, a variational method is employed which shows
the usual Debye—Huckel theory makes the grand thermodynamic
ntial an extremum, the exact result lying between the perfect
and the Debye—Huckel gas. The results enable one to estimate
contributions to the virial expansion of collective oscillations and
hielded particle encounters, whilst avoiding difficulties such as
associated with redundant coordinates. The extension of the
lts to the quantum mechanical case are briefly commented upon.

530.16

18966 **THE PRINCIPLE OF CAUSALITY AND THE SECOND LAW OF THERMODYNAMICS.** Ya.P.Terletskii.
l. Akad. Nauk SSSR, Vol. 133, No. 2, 329-32 (July 11, 1960).
ussian.

Examines whether from the second law, as a statistical law, it
ossible to have a signal (an excitation travelling from source to
eiver carrying negative entropy) propagating with a velocity
ater than that of light in vacuo, and consequently real particles
imaginary rest mass. It is concluded that this can be considered
sically real in reversible micro-processes if the principle of
sality is considered only as a consequence of the second law.
R.Berman

530.16

18967 **KINETIC THEORY OF THE MODERATELY DENSE RIGID-SPHERE FLUID. IV. FLUXES OF MATTER, MOMENTUM, AND ENERGY IN A MIXTURE.**
R.A.Harris and S.A.Rice.
J. chem. Phys., Vol. 33, No. 4, 1047-55 (Oct., 1960).

For Pt III, see Abstr. 3469 of 1960. The perturbation solution of the modified Boltzmann equation is used to obtain the fluxes of matter, momentum, and energy. The fluxes are evaluated to first order in the gradients of density, flow velocity, and temperature, and are left in terms of the Sonine polynomial expansion coefficients. As an example, the calculation of the isothermal diffusion coefficient is carried out for the general D is proportional to $(2kT/m)^{1/2}(N/v\sigma^2)\{[1/g(\sigma)] + (\mathrm{const}/v + \ldots\}$.

530.16

18968 **KINETIC THEORY OF THE MODERATELY DENSE RIGID-SPHERE FLUID. V. RELAXATION IN MOMENTUM SPACE.** R.A.Harris and S.A.Rice.
J. chem. Phys., Vol. 33, No. 4, 1055-8 (Oct., 1960).

The problem of a dense rigid-sphere fluid at equilibrium is considered in configuration space but perturbed in momentum space. The relaxation time for the return to equilibrium is computed analytically and shown to correspond to very few collisions — about four at gas densities and about one at liquid densities. This result is in good agreement with machine computations by Alder and Wainwright and shock-tube measurements by Greene, Cowan and Hornig. The results indicated that correlated successive binary collisions need not be considered to first order in the finite dense rigid-sphere fluid.

530.16

18969 **QUANTUM CORRECTIONS FOR TRANSPORT COEFFICIENTS.** S.-I. Choi and J.Ross.
J. chem. Phys., Vol. 33, No. 5, 1324-31 (Nov., 1960).

The equation of motion of a quantum-mechanical two-particle system is solved without approximation in an expansion in Planck's constant. First-order quantum corrections comprising all contributions to the coefficient of $\hbar^2$ in the expansion are derived for the differential scattering cross-section and the kinetic-theory transport coefficients. Numerical results are obtained for a simple model of molecular interactions, and lack of agreement is found with work based on the W.K.B. solution of the Schrödinger equation.

530.16

18970 **ENSEMBLE METHOD IN THE THEORY OF IRREVERSIBILITY.** R.Zwanzig.
J. chem. Phys., Vol. 33, No. 5, 1338-41 (Nov., 1960).

Describes a new formulation of methods introduced in the theory of irreversibility by Van Hove and Prigogine, with the purpose of making their ideas easier to understand and to apply. The main tool in this reformulation is the use of projection operators in the Hilbert space of Gibbsian ensemble densities. Projection operators are used to separate an ensemble density into a "relevant" part, needed for the calculation of mean values of specified observables, and the remaining "irrelevant" part. The relevant part is shown to satisfy a kinetic equation which is a generalization of Van Hove's "master equation to general order". Diagram summation methods are not used. The formalism is illustrated by a new derivation of the Prigogine—Brout master equation for a classical weakly interacting system.

530.16

18971 **ON MOLECULAR CHAOS AND THE KIRKWOOD SUPERPOSITION HYPOTHESIS.** H.Grad.
J. chem. Phys., Vol. 33, No. 5, 1342-8 (Nov., 1960).

Considers properties which are possessed by typical functions of very many variables such as the n-particle molecular distribution function of a dynamical system. It is shown that such a function "selected at random" will in all likelihood approximately satisfy the molecular chaos condition and, to a better approximation, will very likely satisfy the Kirkwood superposition relation.

530.16

18972 **STRUCTURE OF TRANSPORT EQUATIONS.** S.Tamor.
J. chem. Phys., Vol. 33, No. 5, 1421-5 (Nov., 1960).

The problem of inventing irreversible equations which in some sense approximate the Liouville equation is examined. First a class of solutions of the Liouville equation is defined which have the property of weak convergence to equilibrium. A modified Liouville equation is then constructed which is inherently irreversible and whose solutions constitute an asymptotic approximation to the Liouville equation for those systems which decay to equilibrium. The approximation involves replacing the force term in the Liouville equation by an operator involving the prehistory of the system for a small but finite time. It is found that solutions of this modified equation exist only for time-smoothed distribution functions, and that the smoothing interval must increase slowly with time. This smoothing procedure is essentially the repeated time-smoothing method of Kirkwood.

530.16

18973 STATISTICAL MECHANICS OF THE NONUNIFORM GAS. P.L.Auer and S.Tamor.

J. chem. Phys., Vol. 33, No. 5, 1426-31 (Nov., 1960).

The method of the preceding abstract is applied to the derivation of a transport equation for the nonuniform dense gas. The required short time propagator is computed by an approximation scheme based upon the assumption that the duration of a binary collision is small compared to the mean free time between collisions. A transport equation for the phase space distribution function is obtained in which the "collision operator" satisfies a simple integral equation. The collision operator is nonlocal in the coordinate space and hence contains interference effects between collisions and the streaming motion. The limit of infinite dilution is examined by means of a moment expansion in which case the collision operator reduces to the Boltzmann collision integral. In this limit one obtains the master equation for the nonuniform gas.

530.16

18974 CLASSICAL AND QUANTUM MECHANICAL HYPERVIRIAL THEOREMS. J.O.Hirschfelder.

J. chem. Phys., Vol. 33, No. 5, 1462-6 (Nov., 1960).

If W is a function of the coordinates and momenta, then in classical mechanics the time average of the Poisson bracket (H, W) is zero. In quantum mechanics it follows from the Heisenberg equation of motion that the expectation value of (WH - HW) for any wave-function, corresponding to a stationary energy state of the system, is zero. For each selection of W there is a dynamical relationship, in a time-average or space-average sense, which the system must obey. Two classes of W's are considered in detail: W as a function only of the coordinates, and W as a function of the coordinates times the first power of a momentum. For the first class, neither the classical mechanical nor the quantum mechanical results provide useful information. The usual virial theorem of Clausius is a special case of the second class of relations. The classical treatment should be useful for the determination of the equation of state of liquids. The use of the quantum-mechanical relations for determining the constants in an approximate wave-function is discussed.

530.16

18975 ON TEMPORAL EVOLUTION OF ISOLATED DYNAMICAL SYSTEMS. S.Golden and H.C.Longuet-Higgins.

J. chem. Phys., Vol. 33, No. 5, 1479-84 (Nov., 1960).

It is shown that if $\langle A(t) \rangle$ is the expectation value of a real observable A at time t, then for a finite closed dynamical system $\langle A(t) \rangle$ can converge to a limit as $t \to \infty$ only if $\langle A(t) \rangle$ is altogether independent of t. This conclusion is unaffected by time-smoothing or coarse-graining. On the other hand, for an infinite system whose energy levels form a purely continuous spectrum, $\langle A(t) \rangle$ tends to a limit as $t \to \infty$ under very general conditions. This conclusion does not depend on the introduction of either time-smoothing or coarse-graining.

530.16

18976 ENSEMBLES OF MAXIMUM ENTROPY. J.E.Mayer.

J. chem. Phys., Vol. 33, No. 5, 1484-7 (Nov., 1960).

A theorem is stated and proved. The theorem considers the various possible probability density functions, W_N, in the phase space of all the N molecules of a system, defined for an ensemble for which known mechanical properties require a given set of reduced probability densities, w_n, for small numbers of molecules $n < n_0$. The theorem states that the function, W_N, of maximum entropy is that with the simplest possible correlations between the molecules consistent with the restraint imposed by the fixed w_n, $n < n_0$. It is then shown that the course of the negative entropy flow in a real "isolated" system undergoing spontaneous change is a of negative entropy into the correlation functions of many molec followed by the destruction of these negative entropy terms due the random time dependent fluctuations at the container walls.

53

18977 BOLTZMANN EQUATION AND INVERSE COLLISIO J.T.O'Toole and J.S.Dahler.

J. chem. Phys., Vol. 33, No. 5, 1487-95 (Nov., 1960).

The equations of change for the statistical distribution func involved in the kinetic theory are examined for molecular speci which interact with arbitrary central forces. It is shown that th notion of inverse encounters follows in a straightforward fashio from the fundamental Lioville equation. The analysis also establishes that it is not the usual distribution function, but a particular modification thereof, which should satisfy an equation the Boltzmann variety. Three body collision processes are brie examined and the extension of the method to the domain of chem kinetics discussed.

53.1

18978 PROPERTIES OF LINEARIZED COLLISION OPERA STUDY OF A SPECIAL CASE. J.Naze.

C.R. Acad. Sci. (Paris), Vol. 251, No. 6, 854-6 (Aug. 8, 1960). In French.

Continuing earlier work, (Abstr. 19191 of 1960), integral expressions are found for the eigenvalues of the collision operat K when the molecules are Maxwellian (inverse fifth power force It is suggested that the results lead to an approximate treatment a weakly-ionized gas. H.N.V.Tempe

53

18979 SOME SPECIAL PROPERTIES OF THE BOLTZMAN ELASTIC COLLISION OPERATOR.

J.L.Delcroix and J.Salmon.

J. Phys. Radium, Vol. 20, No. 6, 594-6 (June, 1959). In French.

Some properties of the Boltzmann elastic collision operator are pointed out to be valid in a more general framework than tha of the Lorentz gas.

53

18980 EXPRESSION OF THERMODYNAMIC VARIABLES IN TERMS OF A DISTRIBUTION FUNCTION OF QUASI-PARTICLES. R.Balian and C. De Dominicis.

C.R. Acad. Sci (Paris), Vol. 250, No. 25, 4111-13 (June 20, 1960). In French.

In continuation of a former paper (Abstr. 12371 of 1960), a diagram technique is applied to the calculation of thermodynamic quantities at zero temperature for an anisotropic system. Some difficulties are discussed. H.N.V.Temper

530.

18981 SOME EFFECTS OF HOLE—HOLE INTERACTIONS I SYSTEMS OF FERMIONS. J.Sawicki.

Nuovo Cimento, Vol. 7, No. 6, 893-901 (Sept. 16, 1960).

A generalized reaction matrix of the Brueckner theory is discussed involving the effects of hole—hole interactions in large systems of fermions. Corrections to the real part of the single particle excitation energy are estimated for the cases of nuclear matter and liquid He^3. In accordance with a suggestion by Klein and Prange such corrections to the potential near the Fermi leve may be large while the total energy is enhanced only a little. The effects are sensitive to nuclear density. The problem of the damping factor (i.e., the imaginary energy shift) is discussed.

530

18982 STOCHASTIC EQUATIONS FOR NONEQUILIBRIUM PROCESSES. P.M.Mathews, I.I.Shapiro and D.L.Falko

Phys. Rev., Vol. 120, No. 1, 1-16 (Oct. 1, 1960).

A system of weakly interacting particles is described by a ti dependent joint probability distribution in the occupation numbers the individual particle states. The "master" equation for the dist bution is obtained by considering the time evolution of the system a Markoff process with transition probabilities per unit time give first-order quantum mechanical perturbation theory. This is don for particles obeying classical and quantum statistics. The resul equations include the usual rate equations for the average occupa numbers as special cases; but they also yield all higher moments and correlations in the occupation numbers. The general solutio and its properties are discussed for the case in which a relaxing ystem interacts via binary collisions with a larger system g a fixed but not necessarily thermal distribution. The explicit on for the joint distribution in occupation numbers for all time ıstructed for the case of identical harmonic oscillators which an arbitrary initial distribution. These interact via binary ·ions with a reservoir of similar oscillators, the coupling linear in each oscillator coordinate. This model is also ·alized and solved for a case in which the number of interacting cles is not conserved.

530.16

983 ANISOTROPIC FERMION GAS.
G.Wentzel.

Rev., Vol. 120, No. 3, 659 (Nov. 1, 1960).

ın energy term discovered by Kohn and Luttinger (Abstr. 8568 60) is shown to have a simple geometrical meaning.

530.16

984 STATISTICAL MECHANICS FOR THE NONIDEAL BOSE GAS.
A.E.Glassgold, A.N.Kaufman and K.M.Watson.

. Rev., Vol. 120, No. 3, 660-74 (Nov. 1, 1960).

The equilibrium and quasi-equilibrium properties of a system teracting bosons are studied from a microscopic point of view. equilibrium, the model of Bogolyubov is generalized to finite erature by using the grand partition function. The thermomic properties and the pair-correlation function are calculated. statistical mechanics for moving systems is then developed and ed to the problem of a rotating fluid. For quasi-equilibrium, ral transport equations are derived from first principles, pendent of statistics and model. For the Bogolyubov model, the liar two-fluid hydrodynamics is then derived, leading to the omena of first and second sound.

530.16 : 536.48

985 A VARIATIONAL METHOD FOR THE GROUND STATE OF A BOSE FLUID.
O.Penrose.

. Roy. Soc. A, Vol. 256, 106-14 (May 31, 1960).

A modification of the Rayleigh—Ritz variational principle is ribed which makes possible a calculation of the energy, wavetion, and pair-distribution function $f_{12} \equiv f(x_1,x_2)$ of a Bose fluid, as liquid He^4, at absolute zero. The assumptions made are: vo-body interactions with potential U_{ij}, (ii) trial wave-functions e form $\prod_{i \neq j} \exp \phi_{ij}$, and (iii) the Kirkwood "superposition" oximation. Under these approximations, the expectation energy

$$E = \tfrac{1}{2}n^2 \iint d^3x_1 d^3x_2 f_{12} \Big\{U_{12} - h^2 m^{-1} \Big[(\nabla_1^2\phi_{12}) + (\nabla_1\phi_{12})^2 + + n \int d^3x_3 f_{13} f_{23} \nabla_1\phi_{12} \cdot \nabla_1\phi_{13}\Big]\Big\},$$

re ≡ N/V. It is shown here that making E stationary with res- to independent variations in f and ϕ corresponds to simultane- y applying the ordinary Rayleigh—Ritz principle and solving the ı—Green—Yvon integral equation for f. The method is illustrated eproducing Bogolyubov's results for the case where U is small. case where U is large must be dealt with numerically, but sformations for simplifying the computations are given here.

530.16

986 IRREVERSIBLE PROCESSES IN ISOLATED SYSTEMS.
E.N.Adams.

. Rev., Vol. 120, No. 3, 675-81 (Nov. 1, 1960).

The point of view is taken that the irreversibility paradox schmitt and Zermelo arises because there are two valid trans- equations, one causal, the other anticausal, each consistent the fundamental equations of mechanics. From this point of the problem of irreversibility is to characterize a given non- ibrium distribution as to which transport equation it will obey. g the transport theories of Kohn and Luttinger and of Van Hove, uthor obtains a statistical criterion capable of so characterizing ibution functions of both stationary and time varying types. The tion is discussed of how experimental procedures consistently g about a situation to which the causal transport equation applies; uestion is answered for a very simple kind of experimental tion.

530.16

987 TEMPERATURE DEPENDENCE OF THE LOW-MOMENTUM EXCITATIONS IN A BOSE GAS OF HARD ERES.
F.Mohling and M.Morita.

. Rev., Vol. 120, No. 3, 681-8 (Nov. 1, 1960).

The pseudopotential method is used to calculate the temperature dependence of the low-momentum excitations in a Bose gas of hard spheres to an order beyond that previously known. The correction term is shown to be small compared to the leading term for all temperatures less than the critical temperature T_c. The excitations become poorly defined for temperatures slightly below T_c however, since it is shown that in this region the excitation lifetimes are quite small.

530.16 : 537.2

18988 DIELECTRIC FORMULATION OF QUANTUM STATISTICS OF INTERACTING PARTICLES.
F.Englert and R.Brout.

Phys. Rev., Vol. 120, No. 4, 1085-92 (Nov. 15, 1960).

Formal relations between the free energy, the "dielectric constant" which expresses the response of the system to an external perturbation, and the two-particle Green's function in temperature space are derived. Connection with perturbation expansion for free energy and for general admittance tensors are established. These results are applied to a general discussion of the random-phase approximation at finite temperature and it is shown that the sum on ring diagrams corresponds to the calculation of the dielectric constant in the approximation of the neglect of local field corrections.

530.16

18989 CARTESIAN TENSOR SCALAR PRODUCT AND SPHERICAL HARMONIC EXPANSIONS IN BOLTZMANN'S EQUATION.
T.W.Johnston.

Phys. Rev., Vol. 120, No. 4, 1103-1111 (Nov. 15, 1960).

The electron or ion distribution function, expanded in a sum of spherical harmonics, is shown to be equivalent to a tensor scalar product expansion. As such, it can be readily substituted into the Boltzmann equation to give transport equations integrated over angle and also the necessary equations for determination of the expansion coefficients. This has been done for terms up to order three, the order of the pressure transport tensor.

530.16

18990 STEADY STATE SOLUTION OF THE RELATIVISTIC BOLTZMANN TRANSPORT EQUATION.
I.Abonyi.

Z. angew. Math. Phys., Vol. 11, No. 3, 169-75 (May 25, 1960).

The equation derived in Abstr. 9040 of 1957, with a collision term added, is solved for steady-state conditions. The solution involves a Hankel function whose asymptotic form for $m_0c^2 \gg kT$ gives the solution due to Jüttner (1911). J.Hawgood

530.16 : 537.56

18991 GIANT CLUSTER EXPANSION THEORY AND ITS APPLICATION TO HIGH TEMPERATURE PLASMA.
R.Abe.

Progr. theor. Phys., Vol. 22, No. 2, 213-26 (Aug., 1959).

The conventional virial expansion of thermodynamic functions is converted into a new expansion scheme, similar to the former but more powerful. The new method is particularly suitable to dealing with interactions of long-range character, such as the Coulomb potential, since it suffers from no divergence difficulties contrary to the conventional one. As an application of the method, the equilibrium properties of high temperature plasma are studied and the term of next higher orders than the Debye—Hückel limiting law is obtained exactly. The order estimation indicates that the Debye—Hückel law is accurate within the error of a few percent in this case. A possible extension of the present method to the theory of non-equilibrium properties of plasma or to quantum statistics is suggested.

530.16 : 539.14 : 532.7 : 533.7 : 539.2

18992 RESONANCE ABSORPTION OF NUCLEAR GAMMA RAYS AND THE DYNAMICS OF ATOMIC MOTIONS.
K.S.Singwi and A.Sjölander.

Phys. Rev., Vol. 120, No. 4, 1093-1102 (Nov. 15, 1960).

The theory of resonance absorption of nuclear γ-rays is generalized for an arbitrary system of interacting particles by expressing the relevant transition probability in terms of a space—time self-correlation function, and thus relating the resonance line shape to the incoherent differential scattering cross-section for slow neutrons. Two limiting cases: (a) a gas and (b) a solid have been considered. Discussion regarding the justification of the use of a classical self-diffusion function for a liquid is given and expressions for the broadening of the resonance line due to diffusive motions of the atoms of the interacting system are derived. It is suggested how

Mössbauer-type experiment could be used to give information regarding the diffusive motions of atoms in a solid and also, under more favourable circumstances, in a liquid.

530.16 : 539.19

18993 **STUDIES IN MOLECULAR DYNAMICS. II. BEHAVIOR OF A SMALL NUMBER OF ELASTIC SPHERES.** B.J.Adler and T.E.Wainwright.
J. chem. Phys., Vol. 33, No. 5, 1439-51 (Nov., 1960).

For Pt I, see Abstr. 10207 of 1959. The equation of state and the collision rate for systems ranging in size from four to 500 particles are described. The dependence of the results on the number of particles is qualitatively discussed and in this way insight is gained as to what is required of more accurate analytical theories. By comparing the results to various analytical theories now available their region of validity is established. The number of particles necessary at various densities to obtain a quantitative description of the equilibrium properties is delineated. Whether a first-order phase transition exists for hard spheres remains open until larger systems are investigated.

530.16

18994 **ON THE BROWNIAN MOTION OF A CLASSICAL OSCILLATOR.** M.Toda.
J. Phys. Soc. Japan, Vol. 14, No. 6, 722-8 (June, 1959).

A mechanical treatment is used. The oscillator is coupled with a thermostat which is composed of a great number of harmonic oscillators. By use of a transformation which eliminates the coupling to the first order, the second order quantities such as friction force are obtained. Correlation of random force is also discussed.

530.16 : 539.19

18995 **STUDY OF ROTATIONAL BROWNIAN MOVEMENT OF CHAIN MACROMOLECULES.** P.Wahl.
J. Phys. Radium, Vol. 20, No. 7, 680-2 (July, 1959).
In French.

Study of the rotational Brownian movement of a chain molecule consisting of n rigid links freely rotating. Expressions are given in particular, in the case $n = 2$ and $n = 3$, for the mean square angular displacement of a link during the time interval Δt.

530.16 : 539.2

18996 **RELATION BETWEEN DIRAC AND CANONICAL DENSITY MATRICES, WITH APPLICATIONS TO IMPERFECTIONS IN METALS.** N.H.March and A.M.Murray.
Phys. Rev., Vol. 120, No. 3, 830-6 (Nov. 1, 1960).

It is shown that the canonical density matrix in a single-particle framework may be related directly to the generalized canonical density matrix, containing the Fermi—Dirac function, and to the Dirac density matrix. A study is then made of density matrices in central field problems. A new differential equation is derived, from the Bloch equation, for the diagonal element of the canonical density matrix. In the case of a continuum of energy levels, this is shown to lead directly to a differential equation for the diagonal element of the Dirac matrix, that is, the particle density. Free-electron density matrices are fully worked out and a perturbation theory based on these free-electron forms is presented. It is further shown that for a nonspherical potential energy $V(r)$, the work of Green on the quantum-mechanical partition function may be utilized to yield a perturbation theory for the Dirac matrix. In this way, the correct formulation to replace Mott's well-known first-order approximation for dealing with imperfections in metals is obtained. A brief discussion of the way in which this removes qualitatively the difficulties of the Mott treatment is given and the possibility of direct numerical application in a self-consistent framework is pointed out.

530.16 : 539.2 : 538.2

18997 **EQUATION OF STATE AND PHASE TRANSITION OF THE SPHERICAL LATTICE GAS.**
W.Pressman and J.B.Keller.
Phys. Rev., Vol. 120, No. 1, 22-32 (Oct. 1, 1960).

The spherical lattice gas is a modification of the ordinary lattice gas in which the occupation number of each cell is permitted to be any real number rather than ± 1. However, the sum of squares of the occupation numbers is required to equal the number of cells. This permits one to evaluate the partition function by integrating over the surface of a certain sphere rather than by summing over lattice points on that surface. The partition function and the equation of state of the gas are evaluated in this way. It is found that in three dimensions the gas condenses, but not in one or two dimensions. Graphs of the phase transition curve and of the isotherms three, two, and one dimension are presented. The analytical wo simplified by taking advantage of the relationship between the properties of the lattice gas and of the Ising model of a ferromag This relationship, demonstrated by Yang and Lee (1952) for the ordinary lattice gas and Ising model, also applies to the spherica lattice gas and the spherical model of a ferromagnet. The prope of the latter have been evaluated by Berlin and Kac (1952). Grap of the isotherms of the spherical model of the magnet, which wer found in the course of the work, are also presented.

53

18998 **THE APPLICATION OF INFORMATION THEORY T STATISTICAL PHYSICS.** A.Stahl.
Z. Naturforsch., Vol. 15a, No. 8, 655-62 (Aug., 1960). In Germa

The concept of "disorder" is replaced by that of "lack of information" on the part of the observer, as has been done by va other workers. An actual observer will be unable to measure all the observable properties of an assembly, and thus his informati becomes out of date as time goes on. It is claimed that this imp an increase of entropy with time, and that the "irreversibility paradox" can thus be resolved. H.N.V.Tempe

530

18999 **LOSS AND RECOVERY OF INFORMATION BY COAR OBSERVATION OF STOCHASTIC CHAIN.**
S.Watanabe and C.T.Abraham.
Information and Control, Vol. 3, No. 3, 248-78 (Sept., 1960).

In a stationary stochastic chain, the states are grouped into classes or coarsely defined macrostates, engendering another ch defined in terms of macrostates. Comparison of the information content of these two chains is made in detail. Loss of informatio caused by the coarseness of the definition of macrostates can be recovered, partially or totally depending on the case, when there correlation in the chain. The range of correlation in some cases increased by the coarse definition of states, thus creating a longe "aftereffect". If the correlation is weak, this aftereffect tapers o exponentially with time.

530.

19000 **ON A THEORY OF DISPERSION BY CONTINUOUS MOVEMENTS. II. STATIONARY ANISOTROPIC PROCESSES.** C.C.Lin.
Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 8, 1147-50 (Aug., 1960).

The assumption of isotropy, made in the first paper (Abstr. 14539 of 1960) is here removed. Two basic correlation equations are obtained and a generalized form of Richardson's law is derive from them by asymptotic approximation. G.A.Chisn

530

19001 **ON THE EXACT SOLUTION OF TRANSFER EQUATI IN THE MILNE—EDDINGTON MODEL: CONSERVAT GREY ISOTROPIC SCATTERING.** S.R.Das Gupta.
Indian J. theor. Phys., Vol. 6, No. 2, 39-50 (June, 1958).

The conservative case of isotropic grey scattering of radiati in the outer layers of a star is considered. Chandrasekhar's H-function $H(\mu)$ (giving the law of limb darkening) is obtained in a alternative integral form. A definite advantage of the present integral form lies in the fact that from it one can deduce an analytica consistent closed form of $H(\mu)$ defined for the entire complex μ-plane, by a polynomial curve-fitting in the range (0, 1). A close form of $H(\mu)$ (defined for the entire μ-plane) is useful in mathematical analysis and numerical computations. The present metho of solution differs from the usual Wiener—Hopf technique only in the initial set-up which is so designed as to give the final integral with limits of integration between 0 and 1 instead of between $-\infty$ a ∞. If high accuracy is not required a closed form of $H(\mu)$ involvi a curve-fitting polynomial of degree 4 can be used. Values of $H($ obtained from this closed form agree up to the third decimal plac with Chandrasekhar's determinations of the same from the numer evaluation of his integral form of $H(\mu)$.

530.

19002 **ON THE H-FUNCTIONS FOR ISOTROPIC SCATTERI** D.W.N.Stibbs and R.E.Weir.
Monthly Not. Roy. Astron. Soc., Vol. 119, No. 5, 512-25 (1959).

It is shown that the H-functions for isotropic scattering in a

-infinite plane-parallel atmosphere may be readily and accur-
obtained by direct quadrature of an integral form. Methods are
ribed which enable the accuracy of the calculations to be main-
d in the neighbourhood of singularities in the integrand and its
derivative. The final form has been programmed for the
704 computer, and a total of 160 H-functions have been obtained
alues of the albedo

$$\varpi = 0\ (0.01)\ 0.90\ (0.005)\ 0.95\ (0.001)\ 0.99\ (0.0005)\ 1.0.$$

l agreement has been found in checks involving the zero-order
ent and the first and second moments. The H-function obtained
he conservative case $\varpi = 1$ agrees to within one unit in the sixth
mal place with that computed by Placzek from a modified form
e Wiener—Hopf integral. Tables of the H-function are present-
or $\mu = 0\ (0.05)\ 1.0$ and selected values of ϖ, the tabular values
g rounded to the sixth decimal place. To enable H-functions to
tained for any required value of ϖ, the complete set of com-
d functions has been approximated for $\mu = 0\ (0.05)\ 1.0$ by poly-
ials in ϖ using Chebychev polynomials and the method of least
res, several ranges being used to cover the entire range in ϖ
0 to 1. The H-functions computed from these polynomials are
ect to with one unit in the fourth decimal place. The first-order
ent has also been obtained in polynomial form.

530.19

9003 CONVERGENCE OF CHANDRASEKHAR'S METHOD FOR THE PROBLEM OF DIFFUSE REFLECTION.

.Anselone.
thly Not. Roy. Astron. Soc.,Vol. 120, No. 5, 498-503 (1960).

Let $I(\tau, \mu)$, $J(\tau)$ and $\mathfrak{J}(\tau)$ denote the intensity, average intensity
source function for radiation in a semi-infinite, plane-parallel
ropically scattering atmosphere, with albedo $\varpi_0 \leq 1$ and the only
rnal source due to an incident parallel beam. Let $I_m(\tau, \mu)$,
and $\mathfrak{J}_m(\tau)$ denote the corresponding Chandrasekhar approxima-
s, derived with the aid of either the Gauss or double Gauss
irature formula. It is proved that $I_m \to I$, $J_m \to J$ and $\mathfrak{J}_m \to \mathfrak{J}$
ormly as $m \to \infty$. Error bounds are obtained in the non-
ervative case ($\varpi_0 < I$).

530.19

9004 DISSIPATION FUNCTIONS AND INVARIANT IMBEDDING. I. R.Bellman, R.Kalaba and G.M.Wing.

c. Nat. Acad. Sci. U.S.A., Vol. 46, No. 8, 1145-7 (Aug., 1960).

A new method is suggested for establishing the existence and
queness of the solutions of certain nonlinear functional equations,
ing from various physical processes (e.g. radiative transfer;
previous papers by these authors including Abstr. 273, 6673 of
3; 5568 of 1960), in cases where no creation of matter takes
e. A basic conservation relation is obtained by combining a
s of dissipation functions with those previously described.

G.A.Chisnall

530.19

9005 INVARIANT IMBEDDING, CONSERVATION RELATIONS AND NON-LINEAR EQUATIONS WITH TWO-POINT JNDARY VALUES. R.Bellman, R.Kalaba and G.M.Wing.

c. Nat. Acad. Sci. U.S.A., Vol. 46, No. 9, 1258-60 (Sept., 1960).

Considers a one-dimensional transport process in which
icles are absorbed and scattered by a medium, besides which
isions between backward and forward moving particles result in
her absorption. The corresponding equations are set up and
are to be solved subject to a two-point boundary condition.
servation of particles is used to establish an existence theorem
a unique solution of this type of problem. H.N.V.Temperley

530.19 : 523.82

RADIATION DIFFUSION IN STELLAR ATMOSPHERES.
Abstr. 18796

GENERAL MECHANICS

531.25

006 THE THEORY OF STRESSES IN TWO-COMPONENT GLASS TO METAL TUBE SEALS. H.Rawson.

ci. Instrum., Vol. 37, No. 7, 255 (July, 1960).

See Abstr. 4196 of 1949. Reports an error in an equation and
s the corrected form.

531.25

19007 ON THE STRESSES DUE TO A NUCLEUS IN THE FORM OF A CENTRE OF ROTATION IN AN INFINITE ELASTIC SOLID WITH SPHERICAL INCLUSION.

P.P.Chattarji and S.B.Dutt.
Bull. Calcutta Math. Soc., Vol. 51, No. 4, 186-90 (Dec., 1959).

531.25

19008 SOME PROBLEMS OF PLANE STRESS IN AN AEOLOTROPIC CIRCULAR DISK. U.A.Shastri.

Bull. Calcutta Math. Soc., Vol. 51, No. 4, 154-60 (Dec., 1959).

General expressions for the displacements and stress components both for the aeolotropic and hexagonally aeolotropic circular disk are obtained. By giving suitable values to the elastic constants, solutions given by Love (1952) are deduced as particular cases.

531.25

19009 NOTE ON THE TORSION OF CURVED RODS COMPOSED OF ANISOTROPIC MATERIAL WITH OVAL SECTIONS. A.Chakravorti.

Bull. Calcutta Math. Soc., Vol. 51, No. 4, 161-6 (Dec., 1959).

531.25

19010 A PLANE PROBLEM IN THE THEORY OF ELASTICITY FOR AN INFINITE STRIP, WITH GIVEN BOUNDARY STRESSES OR STRAINS. S.M.Belonosov.

Dokl. Akad. Nauk SSSR, Vol. 131, No. 6, 1291-3 (April 21, 1960).
In Russian.

Mukhleshvili's integral solutions are obtained for both cases and some of their terms are computed and tabulated.

J.K.Skwirzynski

531.25

19011 CONTACT PROBLEM FOR AN ELASTIC LAYER UNDER THE ACTION OF AN ECCENTRIC VERTICAL FORCE ON A CIRCULAR RIGID PUNCH. K.E.Egorov.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 4, 781-4 (Aug. 1, 1960).
In Russian.

The problem is analysed theoretically by finding the normal component in the elastic layer when the punch is subjected to the combined action of a central force and a couple. R.F.S.Hearmon

531.25

19012 THE ELASTIC DEFORMATION OF CONVEX SHELLS IN THE CRITICAL REGION. A.V.Pogorelov.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 4, 785-7 (Aug. 1, 1960).
In Russian.

Using an energy method, equations are derived for the critical buckling load and for the relation between the external load and the bulging of the shell. R.F.S.Hearmon

531.25

19013 STABILITY OF A CYLINDRICAL SHELL, STRENGTHENED WITH RINGS, UNDER ACTION OF EXTERNAL PRESSURE. V.M.Darevskii and R.I.Kshnyakin.

Dokl. Akad. Nauk SSSR, Vol. 134, No. 3, 548-51 (Sept. 21, 1960). In Russian.

The critical pressure is calculated for such a shell with rigidly fixed ends; the method of analysis and notation follows closely that used by the authors previously (Abstr. 12387 of 1960). A shell with 8 rings (shell diameter R = 10.3 cm, shell thickness = 0.038 cm, ring thickness = 0.119 cm, ring width = 0.2 cm, distance between rings $= \alpha R$, where $\alpha = 0.347$) showed critical pressure of 1.72 kg/cm^2, whereas for the same shell without rings, the critical pressure was 0.53 kg/cm^2. J.K.Skwirzynski

531.25

19014 STRESSES IN AN AEOLOTROPIC PARABOLOID OF REVOLUTION DUE TO FRICTIONAL FORCE ACTING ON ITS SURFACE. S.B.Dutt.

Indian J. theor. Phys., Vol. 5, No. 1, 11-14 (March, 1956).

The present paper aims at finding the displacement in a paraboloid of revolution with a material having curvilinear aeolotropy. The shearing stresses which are of the nature of frictional forces and are responsible for the twisting of the solid about its axis of revolution are supposed to be uniformly distributed over the curved surface of the solid of revolution.

531.25

19015 STRESSES IN A SPHERICALLY ISOTROPIC TRUNCATED CONE FITTED WITH TWO RIGID SPHERICAL CAPS DUE TO FRICTIONAL FORCES ACTING ON THE CURVED SURFACE. P.P.Chattarji.
Indian J. theor. Phys., Vol. 5, No. 1, 15-18 (March, 1957).

Torsional stresses and deformations in a spherically isotropic truncated cone fitted with two rigid spherical caps due to frictional forces acting on the curved surface have been obtained.

531.25

19016 ON BENDING OF A CIRCULAR PLATE OF AEOLOTROPIC MATERIAL UNDER CERTAIN NON-UNIFORM DISTRIBUTION OF LOAD. P.Choudhury.
Indian J. theor. Phys., Vol. 5, No. 4, 97-104 (Dec., 1957).

A solution of the fundamental equation for an elastic material with transverse isotropy is obtained in the form of polynomials and is used in discussing the problem of bending of a circular plate under non-uniformly distributed load, the intensity of which follows a parabolic law of distribution.

531.25

19017 NOTE ON THE BENDING OF A THIN UNIFORMLY LOADED PLATE BOUNDED BY TWO EQUAL CONFOCAL PARABOLAS. B.B.Chatterjee.
Indian J. theor. Phys., Vol. 6, No. 1, 35-7 (March, 1958).

The bending of a thin uniformly loaded plate bounded by two equal confocal parabolas is discussed. The boundary is assumed to be clamped and the plate bent by transverse forces.

531.25

19018 STRESS CONCENTRATIONS AROUND A SMALL INCLUSION ON THE AXIS OF A CIRCULAR CYLINDER UNDER TORSION. P.P.Chattarji.
Indian J. theor. Phys., Vol. 6, No. 2, 51-64 (June, 1958).

Stresses are calculated for the case of a small rigid inclusion (i.e., zero displacement on the surface of the inclusion) bonded to a large circular cylindrical shaft in torsion, the axis of the inclusion coinciding with that of the cylinder. The inclusions considered are of the shapes (i) two spheres not touching each other; (ii) two spheres touching each other; (iii) inverse of an ovary ellipsoid with respect to its centre.

531.25

19019 PLASTIC INTERACTION CURVES FOR ANNULAR PLATES IN TENSION AND BENDING.
P.G.Hodge and R.Sankaranarayanan.
J. Mech. Phys. Solids, Vol. 8, No. 3, 153-63 (Aug., 1960).

An annular plate made of a perfectly plastic material is subjected to a uniform normal load over its surface and a constant tensile load around its outer edge. Close bounds on the interaction curve are found for all values of the inner radius under various support conditions at the inner edge.

531.25

19020 STRESS CONCENTRATIONS AROUND A SMALL SPHERICAL INCLUSION ON THE AXIS OF A TRANSVERSELY ISOTROPIC CIRCULAR CYLINDER UNDER TORSION. P.P.Chattarji.
J. Assoc. Appl. Physicists, Vol. 5, 10-15 (1958).

The problem of a rigid spherical inclusion is studied. The results, obtained in closed forms, involve Legendre's associated functions of the second kind of which the values can be easily obtained from tables.

531.25

19021 TORSIONAL STRESSES IN A LARGE THICK PLATE WITH RIGIDITY VARYING EXPONENTIALLY WITH DEPTH. S.B.Dutt.
J. Assoc. Appl. Physicists, Vol. 5, 16-23 (1958).

Two cases are considered: in the first, one face is supposed to be rigidly fixed, with a distribution of shear loads on a circular area on the other face; the second case is concerned with the torsion of the plate by shearing forces prescribed over circular areas over two faces.

53.2

19022 ON THE STRESS DISTRIBUTIONS DUE TO FORCE NUCLEI IN AN ELASTIC SOLID BOUNDED INTERN BY A SPHERICAL HOLLOW AND IN AN ELASTIC SPHERE.
D.Collins.
Z. angew. Math. Phys., Vol. 11, No. 1, 1-16 (Jan. 25, 1960).

531.25

19023 THE SECOND FUNDAMENTAL PROBLEM OF ELASTICITY APPLIED TO A PLANE CIRCULAR R
W.A.Gross.
Z. angew. Math. Phys., Vol. 8, No. 1, 71-5 (Jan. 25, 1957).

By using the complex variable method of Muskhelishvili the author obtains the general solution of the second fundamental pro lem (that in which boundary displacements are specified) for a p circular ring. It is shown that the solution obtained by Reissner [Jahrbuch der Wissenschaftlichen Gesellschaft für Flugtechnik (Luftfahrt), 1928, p. 126 ff.] is not correct. R.Bullo

53 2

19024 THE TRANSVERSE FLEXURE OF A THIN CIRCULA PLATE SUBJECT TO PARABOLIC LOADING OVER CONCENTRIC ELLIPSE. W.A.Bassali.
Z. angew. Math. Phys., Vol. 11, No. 3, 176-91 (May 25, 1960).

531.25

19025 CYLINDRICALLY ORTHOTROPIC CIRCULAR PLAT WITH LARGE DEFLECTIONS. J.Nowinski.
Z. angew. Math. Phys., Vol. 11, No. 3, 218-28 (May 25, 1960).

531 5

19026 NOTE ON THE EFFECT OF A CENTRE OF DILATATION IN A SEMI-INFINITE ELASTIC SOLID WITH ITS PLANE FACE FIXED. S.K.Bhowmick.
Z. angew. Math. Phys., Vol. 11, No. 4, 315-18 (July 25, 1960).

An attempt is made to find the effect of a centre of dilatation the form of a nucleus of elastic strain (say) inside a semi-infinite elastic solid having its plane face rigidly fixed. The method of solution is simple, and the results are obtained in a closed form.

531.25 : 53

19027 SOME KINETIC CONSIDERATIONS OF THE GRIFFIT CRITERION FOR FRACTURE. I. EQUATIONS OF MOTION AT CONSTANT FORCE. J.P.Berry.
J. Mech. Phys. Solids, Vol. 8, No. 3, 194-206 (Aug., 1960).

The implications of the Griffith criterion for fracture in tens and cleavage have been investigated in the region where the crack moving. An anomaly in behaviour is shown to arise if the Griffith criterion is assumed, a priori, to define the critical condition for the beginning of crack growth. The equations of motion have ther fore been derived initially without reference to the criterion for fracture, and the effect of approaching the Griffith condition deter mined by adjustment of a dimensionless parameter. It is conclud that the details of the motion of a crack are determined by the str condition existing at the point of fracture, and that the observed critical stress is (infinitesimally) greater than that given by the Griffith criterion and is probably determined by the size of the defect in the sample and the rate of straining.

531.25 : 53

19028 SOME KINETIC CONSIDERATIONS OF THE GRIFFIT CRITERION FOR FRACTURE. II. EQUATIONS OF MOTION AT CONSTANT DEFORMATION J.P.Berry.
J. Mech. Phys. Solids, Vol. 8, No. 3, 207-16 (Aug., 1960).

For Pt I, see previous abstract. It is shown that the behavio of cracks in tensile samples depends on their initial size and that large cracks are, in one sense, more stable than small cracks. The behaviour of cracks of all sizes in cleavage samples is shown to resemble that of large cracks in tensile samples.

531.

19029 TRAVELLING CRACKS IN ELASTIC MATERIALS UNDER LONGITUDINAL SHEAR.
F.A.McClintock and S.P.Sukhatme.
J. Mech. Phys. Solids, Vol. 8, No. 3, 187-93 (Aug., 1960).

The solution for the stress field around the tip of a crack subjected to longitudinal shear (anti-plane strain) and travelling with constant velocity in an elastic medium, as given by Bilby and

ough (1954), has been extended to a configuration analogous to
ensile case studied by Craggs (1960). As in the case of tensile
ks, the applied stress required for constant velocity is lower
igher crack velocity and there is a critical velocity approxi-
ly 0.6 times that of the shear wave velocity above which the
k will branch. Similar stress levels are found using two
rent fracture criteria: the Griffith energy criterion and the
rion of critical shear strain averaged over a critical area.

531.25 : 518

9030 AN ELECTRICAL ANALOGUE SOLUTION FOR THE STRESSES NEAR A CRACK OR HOLE IN A FLAT
TE. S.C.Redshaw and K.R.Rushton.
lech. Phys. Solids, Vol. 8, No. 3, 173-86 (Aug., 1960).

An electrical analogue for solving the biharmonic equation was
d to determine the elastic stresses near a hole or crack in a flat
tangular plate subjected to uniaxial tension. Problems concer-
; both simply and multiply connected regions were solved by the
hod and, where a comparison between the experimental results
existing analytical solutions was possible, the agreement was
d. The advantages and limitations of the method are discussed
the desirability of extending the method for the determination of
stresses after plastic yielding has occurred, is emphasized.

531.3

9031 MISCONCEPTION CONCERNING THE DYNAMICS OF THE IMPACT BALL APPARATUS. S.Chapman.
er. J. Phys., Vol. 28, No. 8, 705-11 (Nov., 1960).

The impact ball apparatus, which usually consists of a straight
of balls of equal size touching each other, is used for demonstrat-
conservation of momentum. If the balls are perfectly elastic and
re are more than two balls in the row, then if N balls are drawn
de and allowed to strike the remaining group, it is just not true,
is often erroneously supposed, that N balls fly out from the
er end of the row while the other balls remain at rest. The two
nciples of conservation of momentum and of energy are sufficient
etermine the motion after impact of only two balls. If there are
re than two, then the law of force between the balls (a $\frac{3}{2}$ power
) must be invoked. The case for three equal masses with linear
ce law is solved exactly and several consequences are discussed.
merical solutions for the cases of three and four equal spheres
given. Calculations are found to agree with experimental data.
en a single ball of velocity v_0 impacts against two balls in
tact at rest, the velocities after impact are $-0.0710v_0$, $+0.0765v_0$,
$+0.9944v_0$, if the balls are elastic. Since the demonstration is
ays interesting and has many ramifications, it seems unnecessary
mislead students into believing that the velocities of the balls
h relatively little motion arise because of inelasticity or mis-
gnment, neither of which can explain the negative velocity. If
coefficient of restitution is much less than unity, then inelasticity
sks the effects discussed here.

531.3

19032 STRESSES IN CERTAIN THIN PLATES ROTATING ABOUT AN AXIS LYING IN THEIR MIDDLE PLANE.
S.Dhaliwal.
Franklin Inst., Vol. 269, No. 6, 463-73 (June, 1960).

Muskhelishvili's method has been employed for solving
blems of certain thin elastic plates having curvilinear boundaries
rotating steadily about an axis lying in the middle plane of the
te. Considered in detail is the problem of a plate having a
gular curvilinear polygonal boundary, in general. The results for
cular, dumbbell-shaped, cycloidal and cogwheel-shaped plates
e been derived as particular cases. The numerical results are
sented in the form of tables and graphs.

531.3

19033 LOW-FREQUENCY MOTION OF BODIES IN AN ELASTIC WAVE FIELD. J.W.Miles.
Acoust. Soc. Amer., Vol. 32, No. 11, 1396-1401 (Nov., 1960).

The mean translation and rotation of a body having elastic
stants and a density that differ only slightly from those of an
erwise homogeneous medium in which it is imbedded and having
nensions that are small compared with the wavelength are calcu-
ed for an arbitrary incident wave field. The problem is reduced
the evaluation of two integrals in potential theory, and explicit
aluations of these integrals are given for an ellipsoid. The
sults are applied to the motion of a sphere and a prolate spheroid
der the influence of plane P and S waves.

531.38

19034 MOTION OF GYROSCOPIC COMPASS UNDER THE INFLUENCE OF ORDINARY FORCES. Ya.N.Roitenberg.
Dokl. Akad. Nauk SSSR, Vol. 133, No. 5, 1045-8 (Aug. 11, 1960).
In Russian.

Calculates the motion of a gyroscopic compass with mercury ballistic vessels when the ship rolling is described by a frequency spectrum. The corresponding intercardinal deviation is also derived. The calculations are illustrated by a numerical example.

J.K.Skwirzynski

531.4

19035 NOTE ON THE DYNAMICAL COEFFICIENT OF FRICTION. K.C.Kar and C.Dutta.
Indian J. theor. Phys., Vol. 5, No. 1, 19-20 (March, 1957).

MECHANICAL MEASUREMENTS

531.71

19036 A NEW METHOD OF MEASURING GAGE BLOCKS. J.B.Saunders.
J. Res. Nat. Bur. Stand., Vol. 64C, No. 3, 173 (July-Sept., 1960).

The parallel testing interferometer (Abstr. 5588 of 1959) is quite applicable without modifications, to the comparison of lengths of gauge blocks. This note describes the testing of gauge blocks of all lengths, up to several metres, without having to contact them to optical flats.

531.71

19037 GAGE BLOCKS OF SUPERIOR STABILITY: INITIAL DEVELOPMENTS IN MATERIALS AND MEASUREMENT. M.R.Meyerson, T.R.Young and W.R.Ney.
J. Res. Nat. Bur. Stand., Vol. 64C, No. 3, 175-207 (July-Sept., 1960).

The desired improvement of length calibration is tenfold and involves an increase in reliability from 2×10^{-6}in./in. to 1 or 2×10^{-7}in./in. The problem of achieving gauge blocks dimensionally stable to this degree is fundamental and has two aspects; (1) the development of a suitable material and treatment to produce a gauge block with the desired dimensional stability, surface quality, and several other physical properties; (2) the development of instrumentation and techniques for the precise measurement of temporal changes of length, so that stability of test samples may be determined to the required precision. The N.B.S. program has been successful in developing three sets of gauge blocks from two materials that have met the requirements and have shown a dimensional stability of 2×10^{-7} in. per in. per yr over an observed period of one year. A technique for measurement based on the use of a mechanical-electronic comparator and a rigorous application of statistical control have supplied data precise to within $\pm 2 \times 10^{-7}$ in. The processes, technical aspects, and techniques involved in these developments are fully explained, and plans for further investigation and improvement are indicated.

531.71 : 539.2

MEASUREMENT OF DISPLACEMENTS OF ~10^{-9} cm. See Abstr. 17901

531.74 : 522.3

PHOTOELECTRIC METHOD FOR RECORDING CIRCLE READINGS. See Abstr. 18583

531.75

19038 THE CALIBRATION OF THE WEIGHTS BUILT INTO A BALANCE. J.W.Humphries.
Austral. J. appl. Sci., Vol. 11, No. 3, 360-73 (Sept., 1960).

A description is given of a method which facilitates the calibration of the weights built into balances provided with mechanical means for changing the weights. The method does not require the removal of the weights from the balance. Some criteria are established for the purpose of selecting a satisfactory built-in weight system, and three systems which satisfy the criteria are included.

531.75 : 539.12

19039 MEASUREMENT OF SURFACE DENSITY OF THIN FOILS. K.Ramavataram and D.I.Porat.
Nuclear Instrum. and Methods, Vol. 4, No. 4, 239-42 (May, 1959).

A Po^{210} alpha source is used to measure the surface density of thin foils with a resolution of approximately $1\ \mu g/cm^2$. A calibration procedure is described to convert air equivalents to units of surface density. The mass stopping power of Al, Ni, Ag and Au relative to air, at an alpha energy of 3.72 and 4.33 MeV, is reported.

531.76

19040 A MODERN ACCELEROMETER.
P.V.Brüel.

Akust. Beihefte [Acustica], No. 1, 207-11 (1956). In German.

After a survey of the principles of known accelerometer devices a newly-developed accelerometer with barium titanate elements is described, the frequency response and sensitivity of which have been measured on two special types. The construction of a calibration device and the possibilities of converting into a velocity or amplitude meter by integration are discussed.

531.76 : 539.1.07 : 621.317.39

19041 AN APPARATUS FOR MEASURING THE SPEED OF PNEUMATICALLY TRANSPORTED GRAINS BY MEANS OF RADIOACTIVITY. C.A.J.Kritzinger.

Nuclear Instrum., Vol. 1, No. 2, 66-70 (March, 1957).

The individual grains were activated with caesium 137 and shielded scintillation counters 1.8 metres apart used as triggers to start and stop an electronic clock, from which the speed could be easily calculated.

531.78 : 621.317.39

19042 LOW-COMPLIANCE DIAPHRAGM-CAPACITANCE GAUGE FOR MEASUREMENT OF LIQUID PRESSURES OF THE ORDER OF 1 in. WATER. A.S.Lodge.

J. sci. Instrum., Vol. 37, No. 11, 401-3 (Nov., 1960).

The construction of a compact "diaphragm-capacitance" gauge suitable for pressure measurement in viscous liquids is described. Sensitivities in the range 1 to 12 pF/in. water are obtained by using different diaphragm units, and the overall zero stability is about 0.002 in. water over a few hours. The response time is about 5 sec when the gauge is filled with a 50 P liquid and the outlet hole is 0.5 mm in diameter and 2 mm in length.

MECHANICS OF FLUIDS

(See also Magnetohydrodynamics)

532.1

19043 ON THE OSCILLATING CYLINDER VISCOMETER.
Ali Abdel Kerim Ibrahim and Abdel Moniem I. Kabiel.

Z. angew. Math. Phys., Vol. 6, No. 5, 405-7 (Sept. 25, 1955).

In a previous paper (Abstr. 1573 of 1955) an equation for the amplitude of oscillation of the suspended inner cylinder of the apparatus was given. This was neither simple nor direct with respect to η (coefficient of viscosity of the liquid). By the introduction of a dimensionless parameter, this relationship has now been made applicable to Newtonian liquids of any value of η.

R.Schnurmann

532.1

19044 THE INFLUENCE OF VISCOMETER DESIGN ON NON-NEWTONIAN MEASUREMENTS. R.McKennell.

Analyt. Chem., Vol. 32, No. 11, 1458-63 (Oct., 1960).

Uncertainty arising from viscometric data obtained from non-Newtonian fluids is minimized by observing two principal conditions: the shear rate should be uniform throughout the measured sample; and a consistent experimental procedure, including the amount and duration of shear, should be adopted. The effect of shear rate variation within the sample fluid is discussed for some viscometers in common industrial use. The methods available for eliminating variations in shear rate, and hence the tedium of applying corrections to flow curves for different types of non-Newtonian behaviour, are outlined. A viscometer is described which combines uniform shearing conditions with a flexible automatic flow-curve recorder giving a wide range of rheological test programs.

532.1

19045 THE RELATIONSHIP BETWEEN VISCOSITY AND MOLECULAR STRUCTURE. III. ACCURATE MEASUREMENTS OF THE TEMPERATURE DEPENDENCE OF THE ACTIVATION ENERGY OF VISCOUS FLOW IN ETHYLENE GLYCOL.
A.Rauf and M.M.Qurashi.

Pakistan J. sci. industr. Res., Vol. 2, 30-9 (Jan., 1959).

For Pt II, see Abstr. 6571 of 1959. An improved technique is been developed for measuring the viscosity of ethylene glycol between 40° and 120° C. The conclusion is drawn from the results that the variations of ln (1/A) and E/R in the Andrade equation of the dependence of viscosity upon temperature, $\eta = A \exp(E/RT)$, are brought about by the same characteristic property of the molecules.

R.Schnurmann

532.1

19046 ADIABATIC COMPRESSIBILITIES OF ELECTROLYTIC SOLUTIONS. S.V.Subrahmanyam.

J. sci. industr. Res., Vol. 19B, No. 9, 333-6 (Sept., 1960).

The adiabatic compressibility as a function of concentration as studied for aqueous solutions of sodium hydroxide, potassium hydroxide, sodium nitrate, potassium nitrate, sodium thiosulphate, lead nitrate and cadmium iodide, using a glass piezometer. From the compressibility data, sound velocities at different concentrations are calculated for solutions of lead nitrate and cadmium iodide. In both the cases, the calculated velocities show a decrease with increasing concentration, confirming the results obtained by the ultrasonic method. This peculiar behaviour is explained as being due to the relativel heavy mass of the metallic ions.

531.5

19047 A GENERAL THEOREM CONCERNING THE STABILITY OF A PARTICULAR NON-NEWTONIAN FLUID.
S.M.Genensky.

Quart. appl. Math., Vol. 18, No. 3, 245-50 (Oct., 1960).

Rayleigh proved that for an inviscid fluid the existence of a point of inflection in the velocity profile of a steady one-dimensional basic flow is a necessary condition for the growth of a superimposed two-dimensional disturbance. In the present paper a similar theorem is proved for a particular non-Newtonian fluid. The acceleration gradients introduced by the non-Newtonian fluid model into the constitutive equations are found to alter the stability criterion set forth by Rayleigh for an inviscid fluid.

535

19048 FINITE TWO-DIMENSIONAL CAVITIES.
Chia-Shun Yih.

Proc. Roy. Soc. A, Vol. 258, 90-100 (Oct. 4, 1960).

General formulae for generating unsteady potential flows characterized by the presence of a cavity (which can be finite in extent) are presented. The fluid at infinity is either in accelerative motion or at rest, but the two cases are essentially distinct. A class of solution is given explicitly for each case. Steady flows in a gravitational field are also investigated, and a class of solutions representing such flows past a finite cavity is given. Some of the solutions in these three classes have been carried out in detail.

532

19049 SIMILARITY METHODS IN RADIATION HYDRODYNAMICS. L.A.Elliott.

Proc. Roy. Soc. A, Vol. 258, 287-301 (Oct. 25, 1960).

The extent to which problems in radiation hydrodynamics may be tackled by similarity methods is investigated for the case of spherical symmetry. In particular the problem of an intense explosion is considered; by the introduction of radiative heat flux the singularity in a solution by Taylor (1950) is removed.

53

19050 EXISTENCE OF APERIODIC FLOW WITH FREE BOUNDARY. Yu.P.Krasovskii.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 4, 768-70 (Aug. 1, 1960). In Russian.

This note is concerned with the irrotational flow of perfect liquids. It concerns the question whether a single-crest aperiodic surface wave is compatible with the equations of hydrodynamics. Compatibility is established for the flow of a layer of liquid over rough horizontal solid surface provided that the depth is not too large. There is no compatibility if the depth is infinite.

R.Eisensch

53

19051 EQUILIBRIUM AND MOTION OF A SPHERE IN A VISCOPLASTIC LIQUID. U.Ts.Andres.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 4, 777-80 (Aug. 1, 1960). In Russian.

Specifies the rheological properties of a viscoplastic liquid erms of two constants, a yield value of stress and a coefficient iscosity. Derives the maximum sizes of spherical solids which be suspended in the liquid without moving. Experiments were le with falling spheres of sizes greater than the calculated imum values, and the velocities in steady fall were plotted inst the diameter of the spheres. R.Eisenschitz

532.5

.9052 EXPERIMENTS ON THE STABILITY OF VISCOUS FLOW BETWEEN ROTATING CYLINDERS. II. VISUAL SERVATIONS. R.J.Donnelly and D.Fultz.
ic. Roy. Soc. A, Vol. 258, 101-23 (Oct. 4, 1960).

For Pt I see Abstr. 5684 of 1958. Measurements of the hydro-amic stability of viscous flow between rotating cylinders were de with an apparatus similar to that used by Taylor (1923) in original experiments. The ratio of the radii of the cylinders ; 1 : 2. The results confirm Chandrasekhar's theoretical cal-ations within experimental error. The asymptotic form of the bility relation when the cylinders rotate in opposite directions lerived and found to agree with experimental data at hand.

532.5

19053 IMPULSIVE ROTATORY MOTION OF A CIRCULAR DISK IN A VISCOUS FLUID. R.P.Kanwal.
angew. Math. Phys., Vol. 10, No. 6, 552-7 (1959).

Formulae are obtained for the flow set up in a viscous fluid er a thin circular disk in the fluid has been set in angular motion ut its axis by an impulsive couple. J.G.Oldroyd

532.5

19054 THE STOKES FLOW ABOUT A SPINDLE. W.H.Pell and L.E.Payne.
art. appl. Math., Vol. 18, No. 3, 257-62 (Oct., 1960).

532.5

19055 THE PULSATING VISCOUS FLOW SUPERPOSED ON THE STEADY LAMINAR MOTION OF INCOM-ESSIBLE FLUID IN A CIRCULAR PIPE. S.Uchida.
angew. Math. Phys., Vol. 7, No. 5, 403-22 (Sept. 25, 1956).

An exact solution of this problem is presented under the sumption of flow parallel to the axis of the pipe. The total mass flow on time average is found to be identified with that given by gen—Poiseuille's law calculated on the steady component of the essure gradient. The phase lag of velocity variation from that pressure gradient increases from zero for steady motion to 90° pulsation of infinite frequency. The work integral for changing etic energy of fluid throughout one period vanishes, while that energy dissipation by internal friction remains finite and the cess amount caused by the components of periodic motion is ded to the components of steady flow. It is found that the given e of mass flow is attained in pulsating motion by giving the me average pressure gradient as in steady flow, but that the plication of excess work to the steady case is necessary for maintenance of this motion.

532.5

19056 APPROXIMATE THEORY OF THE FLOW OF A VISCOUS, INCOMPRESSIBLE LIQUID IN TUBES OF RMEABLE WALLS. S.A.Regirer.
tekh. Fiz., Vol. 30, No. 6, 639-43 (June, 1960). In Russian.

Axial flow of a liquid in a tube (of not necessarily circular oss-section) is considered; it is assumed that liquid is supplied ough the wall, supposed to be porous. In order to derive the tribution of velocity and pressure the Navier—Stokes equations e used, inertial terms being neglected. Assuming that the speed flow through the pores is small in comparison with the mean eed in axial direction, the ratio of these two velocities is a small rameter; the solution of the equations is expanded in powers of s parameter and obtained term by term by a method of successive proximation. R.Eisenschitz

532.5

19057 SLOW BROADSIDE MOTION OF A FLAT PLATE IN A VISCOUS LIQUID. S.C.Gupta.
angew. Math Phys., Vol. 8, No. 4, 257-61 (July 25, 1957).

It is shown that the general problem can be solved by an ctrical analogy of determining the electrostatic potential of a nducting charged disk at a constant negative potential in vacuum. e case of a circular disk is worked out. T.C.Toye

532.5

19058 OPTIMAL COORDINATES FOR A SIMPLE SHEAR FLOW OVER A FLAT PLATE. Kuo-Tai Yen.
Z. angew. Math. Phys., Vol. 11, No. 3, 228-36 (May 25, 1960).

Reference should be made to Kaplun [Z. angew. Math. Phys., Vol. 5, 111-35 (1954)] who introduced the concept of optimal coordinates for boundary layer problems. By use of the "best" coordinates the boundary layer solutions can be obtained valid over the whole field of flow, and a smooth transition from boundary layer flow to the external flow can be achieved. It is shown that for a simple viscous shear of an incompressible fluid over a semi-infinite plate, parabolic coordinates can be used as the optimal coordinates. T.C.Toye

532.5

19059 THEORY OF THREE-DIMENSIONAL INSTABILITY OF LAMINAR BOUNDARY LAYERS. G.Hämmerlin.
Z. angew. Math. Phys., Vol. 7, No. 2, 156-64 (March 25, 1956). In German.

In the case of large wavelengths, a refined treatment of the three-dimensional instability of laminar boundary layers is made possible by taking into account a further term of the differential equations of the instability. The improved curve of the Görtler parameter $Re(\theta/R)^{1/2}$ for neutral disturbances has a minimum with an instability wavelength approximately equal to 19δ, where δ is the boundary layer thickness. The results of Hämmerlin (1955) are not changed essentially; in particular, the critical values of the Görtler parameter are confirmed and also the fact that the critical wavelength is large.

532.5

19060 A SIMPLE GENERALIZATION OF THE RAYLEIGH BOUNDARY LAYER. E.Becker.
Z. angew. Math. Phys., Vol. 11, No. 2, 146-52 (March 25, 1960). In German.

A simple generalization of the theory of the compressible boundary layer near an infinite flat plate to the case with suction (or blowing out) is given if at the time $t = 0$ the plate is set into motion in its own plane with velocity $u_w \sim t^n$. The normal velocity at the wall shall vary with time according to $v_w \sim t^{-1/2}$. In that case one gets similar boundary layer profiles for all $t > 0$, which can be reduced to the profiles without suction or blowing ($v_w = 0$) by a simple parallel displacement and stretching of the coordinates. As an example, the Rayleigh boundary layer ($n = 0$, u_w = const) is discussed.

532.5 : 536.2

19061 NUSSELT NUMBER FOR LAMINAR FLOW IN A CYLINDRICAL TUBE WITH CONSTANT WALL TEMPERATURE. S.Pahor and J.Strnad.
Z. angew. Math. Phys., Vol. 7, No. 6, 536-8 (Nov. 25, 1956). In German.

The Nusselt number is determined as a function of the Peclet number. This function is represented by a diagram.

532.5

19062 EXPERIMENTS ON THE STABILITY OF SPIRAL FLOW BETWEEN ROTATING CYLINDERS.
R.J.Donnelly and D.Fultz.
Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 8, 1150-4 (Aug., 1960).

Observations on the onset of instability of viscous flow between a rotating vertical inner cylinder and a stationary outer cylinder, complicated by an axial streaming under gravity, confirm quantitatively the theoretical predictions of Goldstein and Chandrasekhar. Axial flow tends to delay the onset of instability in experiments in which the speed of the inner cylinder is gradually increased. At the critical speed, longitudinal vortices, with circulation varying periodically with axial distance, were observed in water (with blue dye as tracer) flowing in the annular gap (length 90 cm and width 3 mm) between a chromium plated aluminium cylinder (radius 6 cm) and a precision-bored Pyrex tube. J.G.Oldroyd

532.5

19063 BEHAVIOR OF ISOLATED DISTURBANCES SUPERIMPOSED ON LAMINAR FLOW IN A RECTANGULAR PIPE. G.C.Sherlin.
J. Res. Nat. Bur. Stand., Vol. 64A, No. 4, 281-9 (July-Aug., 1960).

An investigation was conducted in a horizontal transparent rectangular pipe to study the behaviour, in laminar flow, of an isolated turbulent-like disturbance produced by injecting a quantity of dye into the pipe 39 ft from the entrance. As the resulting mass of coloured water moved downstream, time-distance measurements were made for the front of the dye mass and for the rear of the disturbance. The experimental setup, which is described in some detail, permitted reasonable control over the mean flow rate from which Reynolds number was calculated. The utilization of the data revealed a functional relationship among three quantities: the ratio of the velocity of the rear of the disturbance to the velocity of the front of the dye U_R/U_F; the distance from the origin, X_F; and the Reynolds number R.

532.5

19064 STANDARDIZED TREATMENT OF NON-NEWTONIAN LAMINAR FLOW IN A CIRCULAR PIPE.

M.Yusa and Y.Yoshizawa.
Technol. Rep. Tohoku Univ., Vol. 24, No. 1, 11-18 (1959).

The formulae by which an effective non-Newtonian stress, rate-of-shear relation can be obtained from observed mean flow, pressure gradient data, by means of numerical differentiations, are written in new forms. J.G.Oldroyd

532.5

19065 INTERCORRELATIONS BETWEEN PRESSURE AND VELOCITY AT SINGLE POINTS IN ISOTROPIC TURBULENT FLOW. S.Panchev.

C.R. Acad. Bulg. Sci., Vol. 13, No. 1, 35-8 (Jan.-Feb., 1960). In Russian.

In isotropic turbulence, the mean product of the pressure and a single component of velocity vanishes but higher mean products will in general be non-zero. The present note is concerned with the mean product of the pressure (P) and the density of kinetic energy (E). A deduction of this quantity is made which depends upon assumptions concerning relations between different mean higher products of velocity components. Making use of existing experimental data it is found that

$$\langle PE\rangle/[\langle P^2\rangle\langle E^2\rangle]^{1/2} = 0.056$$

R.Eisenschitz

532.5

19066 INTERCORRELATIONS BETWEEN PRESSURE AND VELOCITY AT TWO [DIFFERENT] POINTS IN ISOTROPIC, TURBULENT FLOW. S.Panchev.

C.R. Acad. Bulg. Sci., Vol. 13, No. 2, 131-4 (March-April, 1960). In Russian.

Utilizing previous results (see preceding abstract), a formula is derived for the mean product of the pressure and a velocity component at a point and a velocity component at another point in a streaming fluid. Conditions are stated under which the mean product is proportional to the $(-\frac{2}{3})$rd power of the distance between the two points. R.Eisenschitz

532.5

19067 THE THEORY OF LOCALLY ISOTROPIC TURBULENCE. A.S.Monin.

Dokl. Akad. Nauk. SSSR, Vol. 125, No. 3, 515-18 (March 21, 1959). In Russian. English translation in: Soviet Physics—Doklady (New York), Vol. 4, No. 2, 271-4 (Oct., 1959).

A new formulation of the theory of locally isotropic turbulence in an incompressible fluid is proposed. It is claimed that it leads to an improved derivation of a well-known formula of Kolmogorov, and yields other results, some of them new. H.N.V.Temperley

532.5

19068 ANALYSIS OF TURBULENT BOUNDARY LAYERS WITH ZERO PRESSURE GRADIENT. J.R.Philip.

Z. angew. Math. Phys., Vol. 10, No. 5, 478-501 (1959).

Considers turbulent boundary layer developed along a flat plate of effective zero thickness. Obtains expressions of the velocity profile and thickness of the boundary layer as well as eddy viscosity and shear stress profiles. The results agree with practical measurements (illustrated) and the author shows that the single hypothesis made (namely that the Prandtl's mixing length $l = ky^m$, where y = normal distance from the plate, while k and m are constants fully discussed) is sufficient to formulate the problem. J.K.Skwirzynski

532.5

19069 MUTUAL CORRELATION BETWEEN PRESSURE AND TEMPERATURE IN A TURBULENT STREAM.

S.Panchev.
C.R. Acad. Bulg. Sci., Vol. 12, No. 2, 117-20 (March-April, 1959 In Russian.

The function of mutual correlation in a homogeneous, isotrop steady-state stream satisfies the equation

$$\kappa(\partial^2 B_{PT}/\partial r^2 + (2/r)\partial B_{PT}/\partial r) = \pm\, \partial B_{PT}/\partial \tau.$$

There exists also an invariant similar to that of Loitzianski:

$$\int_0^\infty r^2 B_{PT}\,dr = \text{const.}$$

F.Lachm

532.5 : 532

19070 HEAT TRANSFER AND REYNOLDS' ANALOGY IN A TURBULENT FLOW WITH HEAT RELEASE.

R.R.Hunziger.
Z. angew. Math. Phys., Vol. 9a, No. 4, 307-15 (Nov. 25, 1958).

A mathematical treatment of the problem of heat transfer in turbulent flow with heat release in a tube. By means of the Lapla transform the boundary value problem of the temperature distribution in a tube of circular cross-section is reduced to a Sturm—Liouville problem, and expressions for the temperature distribution and heat flow along the boundary are obtained in series form A generalization of the Prandtl heat source theorem is used to derive Reynolds' analogy for the heat transfer and fluid friction for turbulent flow with heat release. S.Weintro

53

19071 DOWNSTREAM DEVELOPMENT OF THE WAKES BEHIND CYLINDERS. S.Taneda.

J. Phys. Soc. Japan, Vol. 14, No. 6, 843-8 (June, 1959).

Wake development behind circular cylinders and flat plates w investigated in research water tanks. The aluminium dust metho was used to observe the flow patterns. At the intermediate Reyno number range Kármán vortex streets are formed in the wakes beh cylindrical obstacles. These primary Kármán vortex streets are not stable and are more and more deformed as the distance from the obstacle is increased, and finally break down. Thereafter, however, the wake in most cases begins to rearrange itself again into a configuration of the Kármán vortex street. The dimension of the secondary Kármán vortex street thus produced is much larg than that of the primary one. For the circular cylinder, when the Reynolds number is lower than about 150, the ratio of the wavelen of the secondary vortex street to that of the primary is about 1.8 to 3.6, while it is about 10 when the Reynolds number is higher tha about 150. Sometimes the secondary Kármán vortex street simply decays by viscous diffusion as it moves downstream, but in most cases it rearranges itself again to the next Kármán vortex street.

532

19072 DIFFUSION OF VORTICITY IN VISCO ELASTIC LIQUIDS. S.K.Sharma.

J. Assoc. Appl. Physicists, Vol. 4, No. 3, 113-17 (Sept., 1957).

The hydrodynamical equations for the diffusion of vorticity in viscoelastic liquids are set up. The effect of elasticity of a liquid on the diffusion of vorticity has been investigated for a plane vortex sheet and for the line vortex filament. It is found that the elastic elements in viscous liquids speed up the rate of diffusion o vorticity.

532

19073 RESISTANCE OF A CIRCULAR CYLINDER DUE TO A PAIR OF VORTICES MOVING SYMMETRICALLY.

D.Roy.
Z. angew. Math. Phys., Vol. 10, No. 1, 90-3 (Jan. 25, 1959).

A two-dimensional flow of inviscid fluid is considered in whic a circular cylinder is fixed in a uniform stream and a single pair of equal and opposite vortices is present, situated symmetrically downstream of the cylinder. The downstream force on the cylinde is calculated in the general position, taking into account the instantaneous motion of the vortices and the non-steady nature of the flo

J.G.Oldroy

532

19074 THE DYNAMICS OF TURBO-FLOW.

F.G.Gravalos.
Z. angew. Math. Phys., Vol. 10, No. 4, 347-80 (July 25, 1959).

An analysis of steady, axially symmetric flow of an inviscid, incompressible fluid through a turbine. Starting from the fact that a blade row is equivalent to a force field and hence to a vorticity the concept of "potential force field" is extended. It includes on Mises case when the Euler integral is constant throughout eld. The vortex structure is examined for both the free and ound cases and the problem is reduced to that of solving two al differential equations. The calculation can be completed rically. Whereas the usual treatment yields the flows only at ntrance and exit ports the present method gives the flows everye. Thus blade forms can be calculated and it is possible to see he overall effectiveness depends on design parameters.

R.O.Davies

532.5

9075 DEFLECTION OF JETS BY ADHERENCE TO A CONVEX WALL. M.Kadosch.

hys. Radium, Vol. 19, Suppl. No. 4, 2A-12A (April, 1958). In ıch.

Deflection of a jet by a screen is compared to a jet re-attaching lf to a convex wall (so-called Young-Coanda effect) in terms of oposed theory for the interaction between the nearly isentropic am and adjacent dissipative flows (mixing zone and curved dary layer). Screen deflection emphasizes the mixing process; erence deflection eliminates mixing to such an extent that the rifugal field involved by the deflection appears to become the erning process. Both theory and experimentation are presented.

532.5

9076 JET ISSUING IN ALL DIRECTIONS FROM A THIN SLIT ROUND A CIRCULAR CYLINDER OF SMALL DIUS CONTAINING LIQUID UNDER PRESSURE. L.Sanyal.

angew. Math. Phys., Vol. 8, No. 2, 156-9 (March 25, 1957).

532.5

9077 THE BACK EFFECT OF A WALL ON A JET. H.C.Levey.

ngew. Math. Phys., Vol. 11, No. 2, 152-7 (March 25, 1960).

The problem arises due to current interest in bodies which are ported by jets and stay relatively close to the ground. A theocal study is made of the relation between the momentum and mass of the jet and the ratio h/d, where h = distance of wall from jet ning and d is jet width at opening. As far as these gross features concerned the jet behaves as if governed by parabolic equations n to quite small values of h/d.

T.C.Toye

532.5

19078 THE CAUCHY [AND] POISSON PROBLEM FOR WAVES OF FINITE AMPLITUDE.

.Sretenskii and Ya.I.Sekerzh-Zen'kovich.

l. Akad. Nauk SSSR, Vol. 133, No. 3, 544-5 (July 21, 1960). ussian.

A solution of the equations of hydrodynamics is obtained in the n of a Fourier expansion which specifies propagation of surface es of finite amplitude.

R.Eisenschitz

532.5

19079 DISTURBANCES DUE TO THE MOTION OF A CYLINDER IN A TWO-LAYER LIQUID SYSTEM.

.Carpenter and G. H. Keulegan.

es. Nat. Bur. Stand., Vol. 64C, No. 3, 241-53 (July-Sept., 1960).

The disturbance created at the interface of a two-layer liquid tem by the horizontal motion of a cylinder in the upper layer is died for various sizes and shapes of cylinders, depths of the ids, cylinder velocities, and density ratios. The disturbances into three catergories. First, when the layers are of equal kness, in most cases a train of progressive oscillatory waves is duced at the interface. Second, when the depth of the denser er is much less than the depth of the fresh-water layer, the file of the interface usually resembles that corresponding to itive internal solitary waves. Third, when the depth of the ser layer is much greater than the depth of the fresh-water layer, nost cases an internal hydraulic jump is produced. The characistics of the disturbances in each category are related to the size he cylinder, the depths of the liquids, the cylinder velocity, the sity ratio, and the total distance of travel of the cylinder. A oretical analysis is given for disturbances of the first category.

532.5 : 533.6

19080 PRECISE TRACER MEASUREMENTS OF LIQUID AND GAS FLOWS. C.G.Clayton.

cleonics, Vol. 18, No. 7, 96-100 (July, 1960).

The isotope dilution method involves injection of a tracer at a known constant rate and subsequent measurement of the concentration at a point downstream after mixing has occurred. Accuracies of ±1.5% are attainable. In the pulse velocity method a slug of tracer is injected rapidly and its transit time is measured. Accuracies of ±1% are possible. Methods of injection and measurement are described.

R.D.Smith

532.6

19081 THE MARANGONI EFFECTS. L.E.Scriven and C.V.Sternling.

Nature (London), Vol. 187, 186-8 (July 16, 1960).

The effects named in the title refer to the movement of liquids under the influence of non-uniform surface tension and a number of associated surface phenomena. In this article an extensive literature is briefly reviewed. The scope of the article includes the description of phenomena such as surface elasticity, surface viscosity and diffusion across inter-fluid surfaces and the consequences of these phenomena under laboratory conditions and in industrial processes.

R.Eisenschitz

532.6

19082 EFFECT OF VISCOSITY IN THE DETERMINATION OF SURFACE TENSION BY THE DROP-WEIGHT METHOD.

P.Rajagopala Rao and N.Subramanian.

J sci. industr. Res., Vol. 18B, No. 10, 402-4 (Oct., 1959).

A new formula, taking into account the effect of viscosity, is suggested in place of the conventional equation for the drop-weight method of measuring surface tension. The formula is arrived at by the application of dimensional analysis, involving correlation of the two dimensionless groups $\left(\frac{mg}{D\sigma}\right)$ and $\left(\frac{D\eta}{\sigma\theta}\right)$. The proposed equation is $\left(\frac{mg}{D\sigma}\right) = 3.23\left(\frac{D\eta}{\sigma\theta}\right)^{c}$, where c is greater than zero and dependent on viscosity. The value of c was found to be 0.026 for water and 0.064 for the highly viscous liquid, glycerine. When the surface tension of a liquid has to be measured at a particular temperature, it necessitates the determination of c from the relation

$$mg = 3.23(D)^{c+1}(\sigma)^{1-c}(\eta)^{c}(\theta)^{-c} = \text{constant } \theta^{c}.$$

532.6

19083 DETERMINATION OF FLUID SATURATION IN POROUS MEDIA BY A RADIO-FREQUENCY METHOD.

G.F.Round.

Nature(London), Vol. 188, 305-6(Oct. 22, 1950).

The technique proposed in this very short paper has its origins in high frequency titrations. It is especially useful for water or water solution.

K.Walters

532.6

19084 INSTABILITY OF A ROTATING LIQUID FILM WITH A FREE SURFACE. Chia-Shun Yih and with an appendix by J.F.C.Kingman.

Proc. Roy. Soc. A, Vol. 258, 63-86, 87-8 (Oct. 4, 1960).

The centripetal acceleration of a rotating liquid film is tantamount to a centrifugal force, which tends to cause the liquid film to form rings around the circular cylinder to which it is attached. The stabilizing factors are surface tension and, presumably, viscosity. But it is shown in this paper that instability occurs even for large values of the surface-tension parameter and at small Reynolds numbers. The critical wave-number is shown to depend predominantly on the surface tension. Its dependence on the Reynolds number, R, is slight if R is small, and nil if R is large. The effect of viscosity is therefore essentially to slow down the rate of amplification of the unstable disturbances. The analysis is carried out for both large and small Reynolds numbers, for various ratios of film thickness to cylinder radius, and for various surface tension parameters. (The calculation for intermediate Reynolds numbers turns out to be unnecessary for the purpose of comparison with the experiments obtained. Enough information is provided by the calculations performed for practical applications.) Numerical results are given. Comparison of results obtained from 65 experiments with pure glycerine, water + glycerine mixture, and water with the analytical results shows satisfactory agreement.

532.6

19085 NON-STATIONARY PHENOMENA AT THE INTERFACE BETWEEN PARTIALLY MISCIBLE SOLUTIONS.

R.Brückner.

Naturwissenschaften, Vol. 47, No. 16, 372-3 (1960). In German.

Circulation in the mixing zone between partially miscible solutions can become so vigorous that in the case of ether—acetic acid solution/water, for example, small droplets of ether become entrained in the water. This is caused by a change in the interfacial tension between the solution and the water while acetic acid dissolves in the water.
R.Schnurmann

532.6

19086

NON-STATIONARY PHENOMENA AT THE INTERFACE BETWEEN MISCIBLE LIQUIDS.

R.Brückner.

Naturwissenschaften, Vol. 47, No. 16, 371-2 (1960). In German.

Schlieren are produced when a drop of a liquid is carefully put on the surface of another liquid with which it is miscible. The circulation in the mixing zone is clockwise when $\partial\sigma_2/\partial t > 0$, as has been shown for dioxane on nitrobenzene, and anticlockwise when $\partial\sigma_2/\partial t < 0$, as for a drop of water which has been put on acetic acid.
R.Schnurmann

532.6

19087

IN RELATION WITH SURFACE TENSION.

M.Borneas and I.Băbuţia.

Naturwissenschaften, Vol. 47, No. 16, 373 (1960).

When the liquid was rotated at 100 rev/min, the bubble method (Abstr. 8640 of 1960) showed a minimum for the surface tension in the temperature range 16-18°C for benzene, and 19-22°C for glycol.
R.Schnurmann

532.6

19088

SURFACE TENSION OF DILUTED Bi—U AND Sn—Tl ALLOYS.

E.Herczynska.

Z. phys. Chem. (Leipzig), Vol. 214, No. 5-6, 355-6 (1960).

The surface tension of Bi and Sn and of some alloys of Bi with U, and Sn with Tl, was measured between 300 and 500°C, only alloys containing small amounts of U and Tl being considered. U was found to be slightly surface active with respect to Bi; and the surface activity of Tl with respect to Sn was found to vary with concentration.
J.Thewlis

532.6

19089

TEMPERATURE DEPENDENCE OF THE SURFACE TENSION OF Ge.

V.B.Lazarev and P.P.Pugachevich.

Dokl. Akad. Nauk SSSR, Vol. 134, No. 1, 132-3 (Sept. 1, 1960). In Russian.

Results of determinations, carried out by the method of maximum pressure in gas bubbles, yield for the surface tension the expression $\sigma = 621.4 - 0.261\,(t^\circ - 936^\circ)$, where t° is temperature in deg C, and 936°C is the melting point of Ge.
F.Lachman

532.6 : 536.48

ANISOTROPY OF SURFACE TENSION AT THE BOUNDARY BETWEEN THE SUPERCONDUCTING AND NORMAL PHASES IN TIN. See Abstr. 19566

LIQUID STATE

(*Liquid helium is included under Low-Temperature Physics*)

532.7

19090

SOME TESTS OF THE SUPERPOSITION APPROXIMATION IN THE LIQUID PHASE.

F.P.Buff and R.Brout.

J. chem. Phys., Vol. 33, No. 5, 1417-20 (Nov., 1960).

The statistical mechanical theory of the concentration dependence of the pair correlation function provides a delicate test of the superposition approximation in the liquid phase. The numerical assessment is carried out directly with the use of the experimental X-ray scattering function for liquid argon. It is found that the utilization of superposition in the theoretical expression produces too high a concentration dependence of the first coordination sphere of the radial distribution function. Although the superposition approximation fails for integrals possessing a pure density fluctuation origin, it becomes progressively more useful in applications in which the superposition error is damped by short-range force contributions.

532.7

19091

A MORE PRECISE FORM OF THE SUPERPOSITION APPROXIMATION IN THE THEORY OF LIQUIDS.

I.Z.Fisher and B.L.Kopeliovich.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 1, 81-3 (July 1, 1960). In Russian.

It is proposed to replace Kirkwood's superposition approximation by an analogous formula expressing the four-particle distribution function in terms of the three-particle function. Tw integro-differential equations which must be solved in using the method are formulated. The low-density solution is indicated an is stated to give the first four virial coefficients correctly.
O.Penr

5.7

19092

STATISTICAL MECHANICAL THEORY OF THE VISCOSITY COEFFICIENTS OF BINARY LIQUID SOLUTIONS.

R.J.Bearman and P.F.Jones.

J. chem. Phys., Vol. 33, No. 5, 1432-8 (Nov., 1960).

The method of the pair space linear relations is used to dev a formula for the coefficient of viscosity of a binary liquid soluti from statistical mechanics. When the solution is regular a statis tical-mechanical analogue of the Stokes—Einstein equation is obtained in which the product of the self-diffusion coefficient and th viscosity is expressed as a composition independent average ove the radial distribution function for unlike pairs. The relationshi between the present theory and the results of experimental meas ments of viscosity and diffusion coefficients is discussed at some length, and the Gordon equation for the mutual diffusion coefficie derived.

5

19093

DENSITY CORRELATIONS, CRITICAL OPALESCEN AND THE FREE ENERGY OF NONUNIFORM FLUID

M.Fixman.

J. chem. Phys., Vol. 33, No. 5, 1357-62 (Nov., 1960).

The equivalence is shown of three prior approaches to the theory of critical opalescence: (a) the direct study of the long ra behaviour of the radial distribution function, due to Ornstein and Zernike, (b) the indirect approach by Rocard, who obtained the local pressure in a system of nonuniform density, and (c) the indirect approach by Debye, who obtained the free-energy density i a system of nonuniform density. The molecular aspects of the theory are relieved to some extent from the confines of regular solution theory. The consequences of the Kirkwood superposition approximation, and its necessary revision, are examined.

53

19094

ZONE THEORY OF LIQUIDS.

R.E.B.Makinson and A.P.Roberts.

Austral.J. Phys., Vol. 13, No. 2a, 437-45 (July, 1960).

Solid State Physics Conference (see Abstr. 17864 of 1960). A one-dimensional model is considered in which the potential energ of an electron is nearly periodic over short distances but has no long-range order. The number of states of the electron per unit energy range was calculated numerically for a number of chains c identical delta-function potential wells, the number of wells being usually 2000. The distance between adjacent wells had a cut-off parabolic distribution about the mean value, various values being taken for the r.m.s. deviation σ. It was found that (for positive energies) there is a definite energy gap in which no states appear provided σ is small enough. To throw light on the question of how much of the gap narrowing is produced by the short-range disorde inherent in the model and how much by the lack of order over long ranges, some of the computations were repeated with the short-range disorder smoothed in increasing degree. The narrowing of the gap was thereby progressively reduced. It was found also that similar computations with a model having long-range order but wi variation of the position of the wells about ordered positions exhibited narrowing of the gap comparable to that mentioned above The relation of these results to the conclusions of Gubanov (Abstr. 8087 of 1954) and of Landauer and Helland (Abstr. 410 of 1955) is briefly discussed.

532

19095

SCALED PARTICLE THEORY OF FLUIDS.

E.Helfand, H.Reiss, H.L.Frisch and J.L.Lebowitz.

J. chem. Phys., Vol. 33, No. 5, 1379-85 (Nov., 1960).

A statistical thermodynamic theory is developed employing distance scaling as a coupling procedure. This is an extension to real fluids of the technique applied by Reiss, Frisch, and Lebowitz to rigid-sphere systems. One considers molecules interacting wi pair potential u(r), except for one particle which interacts with potential u(r/λ). This single particle, essential a scaled version c

rmal molecule, is termed a λ-cule. It is convenient to restrict
ussion to potentials with rigid cores at $r = a$ and cutoffs at γa.
ntion is focused on a function, $\Theta(\lambda, \rho, T)$, which reduces to G
str. 10624 of 1959) in the case of rigid spheres. The pressure,
nical potential, and work of expanding a λ-cule are simply re-
d to Θ. One can write Θ exactly for $\lambda < 1/2\gamma$ and simple connec-
conditions hold at $\lambda = 1/2\gamma$. An integral condition and $\lambda = \infty$ con-
on on Θ also exist. While Θ is not completely specified, the
going conditions determine much of its behaviour.

532.7

9096 ON THE THEORY OF THE CRITICAL POINT OF A SIMPLE FLUID. M.S.Green.

hem. Phys., Vol. 33, No. 5, 1403-9 (Nov., 1960).

The consequences of a new system of integral equations for
theory of the critical point are discussed. Reasons are given
believing that the fundamental assumption of the Ornstein—
nicke theory about the direct correlation function is incorrect.

532.7

9097 CELL METHOD IN GRAND CANONICAL ENSEMBLE.

J.M.Richardson and S.R.Brinkley, Jr.

hem. Phys., Vol. 33, No. 5, 1467-78 (Nov., 1960).

A variational form of the cell theory of multicomponent liquids
ormulated on the basis of the grand canonical ensemble. The
thod can in principle be extended to any desired level accuracy.
re explicit results are obtained for the case in which each cell
contain at most one particle and the correlation between cells
neglected. In addition, a higher order theory is presented in
ich correlations in the modes of occupancy of cells is treated
the second order. The relation between the radial distribution
ction and the results of the simpler cell theory is considered.

532.7

19098 CELL THEORY OF CLASSICAL LIQUIDS. PHASE TRANSITION BETWEEN GAS, LIQUID AND SOLID.
YVON'S METHOD AND ITS GENERALIZATION. T.Morita.

Phys. Soc. Japan, Vol. 14, No. 5, 563-70 (May, 1959).

For Pt I-II, see Abstr. 8034 of 1959. The method proposed by
on of starting with the cluster expansion formulae and classifying
contributions of the clusters according to the form of the figure
owing coordinates of particles in the summand, is fully developed
uniform and non-uniform lattice systems and compared with the
ster variation method. The cell theory of liquids is investigated
m the standpoint of this method. It is shown that the cell-pair
proximation developed in Pts I and II from the standpoint of the
ster variation method is shown to be identical to the approxima-
n in which the figures that are contained in a cell or a pair of
lls are taken into account correctly and the others neglected.

532.7

19099 CELL THEORY OF CLASSICAL LIQUIDS. PHASE TRANSITION BETWEEN GAS, LIQUID AND SOLID.
F.C.C. LATTICE GASES. T.Morita.

Phys. Soc. Japan, Vol. 14, No. 5, 570-7 (May, 1959).

The method developed in Pt III (see previous abstract) is
plied in the approximation of the "prism of 6 points" to the face-
ntred cubic lattice gases, of nearest neighbour lattice sites dis-
ice a/2, composed of particles with a hard core of diameter
mewhat small than a, with and without an attractive part. The
sults obtained are that these lattice gases exhibit the solid-gas
ase transition, while the liquid phase does not appear for systems
particles either with or without attractive interactions. Qualita-
e discussions are given why the lattice gas will not become
uid whereas the real gas condenses to liquid.

532.7

19100 COMPARISON OF THE ACTIVATION ENERGY OF MOLECULAR ORIENTATION WITH THE ACTIVATION
ERGY OF VISCOUS FLOW. M.F.Vuks.

tika i Spektrosk., Vol. 9, No. 1, 92-4 (July, 1960). In Russian.

The orientational relaxation times (τ) of many liquids over the
nge 20-200°C, deduced from the spectral line broadening, obeyed
aw $\tau = \tau_0 \exp(U_{or}/RT)$, where U_{or} is the activation energy of
ientation. The relaxation times obtained in this way agreed, in
ost cases, with the dipole relaxation times deduced from dielectric
sses. Comparison of the published energies of activation of
scous flow, U_v, with the U_{or} values showed that in the majority of
ses $U_{or} = U_v$ and in the remainder $U_{or} < U_v$. A.Tybulewicz

532.7

19101 THE THERMODYNAMIC INTERPRETATION OF THE TEMPERATURE DEPENDENCE OF THE DIFFUSION COEFFICIENT NEAR THE CRITICAL SOLUTION TEMPERATURE.

L.O.Sundelöf.

Ark. Kemi, Vol. 15, No. 27, 317-21 (1960).

The diffusion coefficient of a half molar solution of nitrobenzene in n-hexane has previously been measured near the critical solution temperature (19.9°C) and found to decrease towards zero. Irreversible thermodynamics leads to the expression $D = Ka_{11}\rho^{-1}(\partial\mu_1/\partial x_1)_{p,T}$ where K depends on concentration (constant in this case), ρ is the density, μ_1 the chemical potential, x_1 the mole fraction of one constituent and a_{11} is an Onsager kinetic coefficient. Using some unpublished data on solution properties due to Neckel and Volk, it is shown that the most of the variation of D comes from the last factor, the small residual changes in a_{11} being proportional to viscosity. R.O.Davies

532.7

19102 KINETIC THEORY OF THERMAL DIFFUSION IN DILUTE POLYMER SOLUTIONS. J.S.Ham.

J. appl. Phys., Vol. 31, No. 11, 1853-8 (Nov., 1960).

A simple Brownian motion model is used to discuss thermal diffusion in dilute polymer solutions. The thermal diffusion coefficient is found to be independent of polymer at sufficiently large molecular weights and to be given by $D_T = -(D_S E_S)/RT^2$ where D_S is the self-diffusion of the solvent and E_S is the activation energy for this diffusion. This suggests that the thermal diffusion ratio $\alpha = TD_T/D_0$ should show a marked temperature dependence, a molecular weight dependence proportional to $M^{\frac{1}{2}}$, and a concentration dependence governed for the most part by that of D_0. The results are shown to agree with published data in most respects and are contrasted to the results of other theoretical models. The results indicate that thermal diffusion is not a particularly promising method of fractionating various molecular weight molecules.

532.7

19103 EXPERIMENTAL STUDY OF THERMAL DIFFUSION IN DILUTE SOLUTIONS OF HIGH POLYMERS.

F.C.Whitmore.

J. appl. Phys., Vol. 31, No. 11, 1858-64 (Nov., 1960).

A simplified theory was derived in the preceding abstract for thermal diffusion in dilute solutions of high polymers. It is of interest to apply this theory to two different types of polymer solutions: (a) dilute solutions in a good solvent, and (b) dilute solutions in a poor solvent. By studies of the concentration, temperature, and molecular weight dependence of the thermal diffusion ratio in these two different types of polymer solutions, it has been possible to obtain a detailed test of the theory.

532.7

19104 DIFFUSION OF WEAK ELECTROLYTES.

W.H.Stockmayer.

J. chem. Phys., Vol. 33, No. 5, 1291-2 (Nov., 1960).

An expression is obtained by standard irreversible thermodynamics for the diffusion coefficient of a weak electrolyte in rapid equilibrium with an arbitrary number of species. The general result reduces to a simple form if all mobilities are independent of concentration.

532.7

19105 FLOW EQUATIONS AND FRAMES OF REFERENCE FOR ISOTHERMAL DIFFUSION IN LIQUIDS.

J.G.Kirkwood, R.L.Baldwin, P.J.Dunlop, L.J.Gosting and G.Kegeles.

J. chem. Phys., Vol. 33, No. 5, 1505-13 (Nov., 1960).

Equations for testing Onsager's reciprocal relations for isothermal diffusion depend on the frame of reference chosen for the flows. This subject is considered for certain frames of reference, as is the problem of measuring diffusion coefficients when there is a change of volume on mixing. Frames of reference discussed are those moving with the local centre of mass, the local centre of volume, the local velocity of the solvent (or of any single component), and that fixed on the diffusion cell. Multicomponent systems, both of strong electrolytes and nonelectrolytes, are considered. An expression is derived which relates the flow of a component in the cell-fixed frame of reference to the flows in any other frame of reference when there is a change of volume on mixing. This relation is used to show that a flow relative to the cell becomes identical to that in the volume-fixed frame as the initial differences in concentration within the diffusion cell are made sufficiently small. Throughout this article a special effect has been made to present derivations and final equations in a form well adapted for use in experimental work.

532.7

19106 EQUATIONS FOR DETERMINING DIFFUSION COEFFICIENTS IN LIQUID SYSTEMS BY THE DIAPHRAGM CELL TECHNIQUE. F.A.L.Dullien and L.W.Shemilt.
Nature (London), Vol. 187, 767-8 (Aug. 27, 1960).

The study of diffusion through a porous diaphragm separating two cells containing the two liquids of differing concentration requires two assumptions: constant solution volumes and constant flux through the porous medium. The author has omitted the second assumption and used a numerical method for solving the differential equations. The results show that the use of the assumption produces only small changes in the results. The assumption of constant solution volumes can lead to large errors, however, whenever the system displays large volume change on mixing. A more general approach is made, which gives equations that can be used for large concentration difference. T.C.Toye

532.7

19107 SOME FURTHER REMARKS ON THE COEFFICIENT OF SELF-DIFFUSION IN SIMPLE DENSE FLUIDS.
S.A.Rice.
J. chem. Phys., Vol. 33, No. 5, 1376-8 (Nov., 1960).

The self-diffusion coefficient in a simple dense fluid is calculated from the autocorrelation function of the momenta. If the randomization of momentum is rapid, the resultant diffusion coefficient differs from that first suggested by Kirkwood, Buff and Green by only $(2/\pi)^{1/2}$. The physical basis of this result is considered. A very simple method of demonstrating the necessity for molecular correlations in the approach to equilibrium is discussed.

532.7 : 536.2

19108 NUMERICAL CALCULATION OF THE DIFFUSION EVAPORATION WITH A CONVECTION TERM.
E.Batschelet and F.Grün.
Z. angew. Math. Phys., Vol. 7, No. 2, 113-20 (March 25, 1956). In German.

A method is described for numerically solving an elliptic type differential equation connected with a diffusion problem with superimposed convection. The method consists in replacing the differential equation by a set of simultaneous difference equations which are solved exactly, thus avoiding difficulties inherent to the relaxation method. An example is treated in detail and the truncation error is discussed.

532.7

19109 SELF-DIFFUSION MEASUREMENTS IN LIQUIDS BY THE SPIN-ECHO TECHNIQUE. D.E.Woessner.
Rev. sci. Instrum., Vol. 31, No. 10, 1146 (Oct., 1960).

A new method for spin-echo self-diffusion measurements is presented. The magnetic field gradient, instead of the r.f. pulse interval, is varied; hence, the oscilloscope sweep and pulser settings need not be changed during measurements. Requirements on H_1 are discussed.

532.7

19110 ON THE STUDY OF DIFFUSION USING SPIN ECHOES. B.Muller and M.Bloom.
Canad. J. Phys., Vol. 38, No. 10, 1318-27 (Oct., 1960).

The decay of the primary spin echo due to diffusion is governed by the expression $\exp[-\frac{2}{3}\gamma^2 G^2 D \tau_1{}^3]$. This statement is independent of the angles through which the magnetization is rotated by the radio frequency (r.f.) pulses. For the usual range of experimental values, it is also independent of the intensity or homogeneity of the r.f. field, the duration of the r.f. pulse, and the magnitude of the constant field gradient.

532.7

19111 ON THE PROBLEM OF THE STRUCTURE OF LIQUID ANTIMONY. Ya.I.Dutchak.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 314-15 (Feb., 1960). In Russian.

The radial distribution curve for liquid Sb, constructed from X-ray data obtained at 640°C, had three maxima at r = 2.85, 4.0, and 5.65 A. The coordination number, calculated from the surface area under the first maximum, was 6.8. Since the corresponding coordination numbers for crystalline and amorphous Sb are 4 and 3, respectively, different structures for liquid, crystalline, and amorphous Sb can be postulated. M.H.Slo

53

19112 TRANSPORT PROCESSES IN LIQUID ALLOYS. II. THE ELECTRICAL FORCE ON AN ION.
P.C.Mangelsdorf, Jr.
J. chem. Phys., Vol. 33, No. 4, 1151-61 (Oct., 1960).

For Pt I, see Abstr. 7579 of 1959. The electrolytic migrati velocities of impurity ions in liquid metals suggest the existenc of strong net electrical forces on these ions, although other mecanisms are possible. On the basis of a detailed model of a liquid metal the early theory of Skaupy is revived and revised. In dilu solution a total electrical force, proportional to the conductivity increment produced by a solute, is exerted on the solute and on nearby solvent when the electric field is applied. The part of th force on the solute ion may be opposed to the part on the solvent Implications for the resistivity of liquid alloys are discussed, including a possible effect in very dilute solutions when the solut ions are further apart than one mean free path. The effective number of free electrons in pure liquid mercury is provisionally estimated to be 0.3 per atom.

532.7 : 53

19113 CHANGES IN CONDUCTIVITY OF PURE WATER CAUSED BY X-IRRADIATION. K.Schmidt.
Nature (London), Vol. 187, 931-2 (Sept. 10, 1960).

Pure water subjected to an intense pulsed beam of X-rays, o the range 10 to 30 000 c/s, undergoes a change in conductivity whi appears to involve two effects — a reversible increase during th irradiation, with a return to zero after each pulse, and an irreversible increase which continues until the end of the irradiation. The reversible effect is attributed to formation of a radical ion $\cdot O_2^-$, and the irreversible effect to the formation of percarbonic ac C.B.Allso

53

19114 HIGH-TEMPERATURE X-RAY DIFFRACTION STUD OF MOLTEN SALTS. II. THE LIQUID STATE STRUCTURE OF THE CHLORIDES LiCl, NaCl, KCl, $BaCl_2$ AND OF THE FLUORIDE CaF_2. GENERAL CONSIDERATIONS OF TH STRUCTURE OF MOLTEN HALIDES. J.Zarzycki.
J. Phys. Radium, Vol. 19, Suppl. No. 4, 13A-19A (April, 1958). I French.

For Pt I see Abstr. 6778 of 1960. The analysis of the radial distribution curves deduced by Fourier transform from the X-ray diffraction spectra of molten salts confirms the results already obtained for alkali fluorides: in the liquid state the low-range ord of the crystal is conserved but the first coordination number is much lower. This proves the lacunar structure of molten halides It is shown that the holes are actually "fluctuating cracks" betwee ionic clusters grouping 1-2 ionic shells around a central ion.

53

19115 X-RAY SMALL ANGLE MEASUREMENTS ON 1% SOLUTION OF HAEMOGLOBIN CORPUSCULAR PROTEIN. T.Ratho.
Indian J. Phys., Vol. 33, No. 11, 469-72 (Nov., 1959).

The small angle scattering due to 1% solution of haemoglobin 0.85% solution of NaCl has been investigated. It has been observe that the scattering curve in the region from 600 A to about 900 A fairly horizontal, showing the absence of interparticular interferen and molecular association.

532

19116 X-RAY SCATTERING BY A CELL-MODEL LIQUID. L.H.Lund.
J. chem. Phys., Vol. 33, No. 4, 1086-93 (Oct., 1960).

The X-ray scattering by a cellular model of a liquid is characterized in terms of a cell-centre pair distribution function and a function descriptive of the cell model employed. Presented also are cell-centre pair distribution functions for liquid argon as calculated by inverting the theoretical formula for the scattered intensity.

532.7 : 533.7 : 539.2 : 539.14 : 530.

THEORY OF γ-RAY RESONANCE ABSORPTION IN LIQUIDS.
See Abstr. 18992

532.7

117 **STRUCTURE IN IONIC SOLUTIONS. IV.** G.W.Brady.

iem. Phys., Vol. 33, No. 4, 1079-82 (Oct., 1960).

For Pt III, see Abstr. 1146 of 1959. X-ray measurements in $_3$ and ErI_3 solutions indicate that there is a firmly held octa- al arrangement of H_2O molecules around the Er^{3+} ion. In ion, there are present Er^{3+}-Cl_2^- and Er^{3+}-I_2^- ion-pair com- es. Finally there is a large amount of order introduced into the cture by the presence of the ions, with evidence for an "icelike" i-lattice.

532.7

19118 **SOLUBILITY OF HYDROGEN AND DEUTERIUM IN LIQUID ARGON.** H.Volk and G.D.Halsey, Jr.

hem. Phys., Vol. 33, No. 4, 1132-9 (Oct., 1960).

The solubility at pressures from 10 to 100 atm is reported. bility isotherms were measured between 87° and 140° K for rogen and between 87° and 120° K for deuterium. The dependence enry's constant on temperature, pressure, and concentration, heats of solution, the partial molar volume of hydrogen in liquid on, and the second virial coefficients of hydrogen and deuterium ne liquid solution are reported. The increase in the solubility euterium over hydrogen is 21.3%, 20.2% and 18.5% respectively, 7, 100, and 120° K. This isotope effect is discussed as a quantum rection to the free volume. Comparison between theory and experiment indicates that the LJD free volume is too large by approxi- ely a factor of five.

532.7

19119 **GERMANIUM AND SILICON LIQUIDUS CURVES.** C.D.Thurmond and M.Kowalchik.

l Syst. tech. J., Vol. 39, No. 1, 169-204 (Jan., 1960).

New measurements are reported on the solubility of germanium iquid gallium, thallium, tin, arsenic, bismuth, cadmium and zinc, the solubility of silicon in liquid indium, tin, lead, antimony, muth and zinc. The measurements of other workers are re- wed, including those of the solubility of germanium and silicon iquid copper, silver, gold and aluminium; of germanium in uid indium, lead and antimony; and of silicon in liquid arsenic nickel. All but two of the liquidus curves can be described hin experimental error by a two-constant equation. The form of s equation suggests that the liquid solutions exhibit certain simple rmodynamic properties, and some evidence is cited indicating t the constants of this equation can be used to estimate the excess e energy of the solutions. Figures for the complete liquidus ves of these binary systems (T-x and log x-1/T) are not included. references are given.

532.7

19120 **THE SOLUBILITY OF KRYPTON IN LIQUID LEAD, TIN, AND SILVER.** G.W.Johnson and R.Shuttleworth.

il. Mag. (Eighth Ser.), Vol. 4, 957-63 (Aug., 1959).

The solubility of krypton in liquid lead and liquid tin was asured by means of radioactive Kr^{85}. In the temperature range 0° to 1300° C for lead and 1100° to 1300° C for tin, the Ostwald efficient r (volume of gas dissolved in unit volume of metal) ries with temperature according to the empirical relation

$$r = \frac{r_\infty}{\text{antilog } T_S/T'}$$

d the thermodynamic equation

$$r - \frac{h^3}{(2\pi mkT)^{3/2}} \frac{1}{a^3} \exp\left(\frac{S}{R}\right) \exp\left(-\frac{H}{RT}\right),$$

ere $1/a^3$ is the number of metal atoms in unit volume, m the mass a krypton atom, H is the energy needed to transfer an atom at st in the gas into solution in the metal, and S the vibrational tropy of a krypton atom dissolved in the liquid metal. The values H are approximately equal to the surface area of a krypton atom ltiplied by the surface energy of the liquid metal, and the vibra- nal entropies of the gas atoms are less than those of the metal oms corresponding to a greater vibrational frequency. No solu- ity was detected in liquid silver showing that $r < 10^{-7}$, i.e. when ypton pressure is 1 atm the atomic fraction dissolved is less than $^{-11}$.

532.7

19121 **THE THERMAL CONDUCTIVITY OF WATER. AN INVESTIGATION OF A REPORTED ANOMALY.**

R.W.Powell and A.R.Challoner.

Phil. Mag. (Eighth Ser.), Vol. 4, 1183-6 (Oct., 1959).

Thermal conductivity determinations made on water in a guarded hot-plate apparatus over the range 24° to 48° C for two sample thicknesses are in agreement with earlier work. They fail to confirm the departure from the smooth curve, reported by Frontas'ev as occurring at about 35° C.

532.7

19122 **SOME CONSEQUENCES OF THE BEHAVIOUR OF MOBILE MOLECULES.** G.Burrows.

Vacuum, Vol. 7-8, 3-18 (1957-58: publ. April, 1959).

The effects of attractions and repulsions between molecules are discussed in an elementary way, with particular reference to evaporation, solution, diffusion, and adsorption. Practical examples are considered, and some equations are given in forms that are suitable for direct substitution of commonly-known values.

532.7

19123 **DISTRIBUTION OF ATOMS IN LIQUID Hg, Ag and Au.** O.Pfannenschmid.

Z.Naturforsch., Vol. 15a, No. 7, 603-12 (July, 1960). In German.

A method is described for the X-ray structure investigation of liquid metals, using a proportional counter and a discriminator. The advantages are discussed. Melts of Hg,Ag and Au were investigated, the curves of intensity and atomic distribution (three maxima) were very similar, the maxima nearly equidistant. There was no sign of the existence of a loosened close-packed structure. The equidistance of the maxima suggested an approximately linear arrangement of the atoms within small ranges. A critical survey on the theory and some essential points for a theory of melts are given. H.E.Schmid

532.7

19124 **SURVEY OF THE METHODS OF MEASURING ACOUSTIC RELAXATION IN AQUEOUS SOLUTIONS.**

K.Tamm.

Z. Elektrochem., Vol. 64, No. 1, 73-8 (1960). In German.

In aqueous solutions relaxation processes occur which are caused by the interactions of dissolved molecules (ions in electrolyte solutions) with one another and with the solvent. The question of measuring methods for acoustic relaxation is relatively simple if one starts from a description of the relaxation process itself. A limiting factor in such measurements is the weakness of the relaxation effect for small concentrations. Acoustic relaxation is found if the chemical equilibrium is dependent on acoustic field parameters and if the rate of establishment of equilibrium is finite. In liquids and gases the acoustic field parameters are given by pressure, compression and temperature, respectively, which are connected by the equation of state at equilibrium. In aqueous solutions and pure water, because of the small thermal expansion (especially at 4°C), sound is very weakly coupled to temperature oscillations; therefore the temperature dependence of equilibria caused by sound does not appear in aqueous media. Some methods of measuring acoustic relaxation are presented.

532.7 : 534.22

19125 **ULTRASONIC RELAXATION DUE TO ROTATIONAL ISOMERISM IN ORGANIC LIQUIDS.** R.A.Padmanaban.

J. sci. industr. Res., Vol. 19B, No. 9, 336-40 (Sept., 1960).

Ultrasonic absorption and velocities in some substituted ethanes, having rotational isomers with considerable energy difference, were studied by a pulse method, in the frequency range 10-110 Mc/s, over the range of temperature from —70° to + 100°C. The absorption data are employed to obtain the relaxation parameters for these liquids, and to derive molecular information such as energy barriers involved in their internal rotation, energy difference between rotational isomers, etc.

532.7 : 534.2

19126 **ULTRASONIC RELAXATION DUE TO ROTATIONAL ISOMERS.** J.Lamb.

Z. Elektrochem., Vol. 64, No. 1, 135-41 (1960).

An outline is given of the information which may be obtained from a study of ultrasonic relaxation due to rotational isomers. It is shown that heats of reaction and the energy barriers hindering rotation can be evaluated from the ultrasonic experiments provided certain qualifying assumptions are made, the most significant of which is that of negligible volume change of reaction. A survey is given of the energy parameters which have been obtained for various isomeric equilibria including new results for substituted propanes and ethanes. A discussion is given of the importance of dipole moment associated with each isomeric configuration in determining the heat of reaction and the activation energy barrier. A particular feature of these measurements is that the potential barrier hindering internal rotation is obtained directly from experiment.

532.7 : 77

19127 PHOTOGRAPHIC OBSERVATIONS ON SHOCK WAVES IN LIQUIDS. H.G.David and A.H.Ewald.

Austral. J. appl. Sci., Vol. 11, No. 3, 317-20 (Sept., 1960).

A simple method of photographing shock waves in liquids and of observing the absorption spectra of solutions under the extreme pressure and temperature conditions of shock waves is described. A thin layer of argon, compressed and heated by a shock wave, is used as a high intensity, short duration (0.2 μsec) flash source. The absorption spectra of the uranyl and neodymium ions are shown to be altered under these conditions.

532.7

19128 ULTRASONIC STUDIES IN ELECTROLYTES — EFFECT OF CONDUCTION ON COMPRESSIBILITY. B.Krishnamurty.

J.sci. industr. Res., Vol. 18B, No. 9, 362-4 (Sept., 1959).

From theoretical considerations, in terms of the Debye—Hückel theory, it has been suggested that the effect of the relaxational and electrophoretic forces is to decrease the adiabatic compressibility, and that the decrease at any concentration is proportional to the square root of molar concentration. To verify this experimentally, the effect of conduction of a number of electrolytes on their adiabatic compressibility was studied. Employing the ultrasonic technique, the adiabatic compressibilities in aqueous solutions of ten electrolytes at different concentrations and consisting of the three valence types, 1-1, 2-2 and 2-1, both when they conduct and when they do not, were determined. It was found that in all cases, the adiabatic compressibility decreased at all concentrations when the electrolyte conducted and that the decrease was proportional to the square root of the molar concentration. The ratio of the decrease of compressibility to the square of molar concentration was constant for each salt; the salts belonging to the same valence type had nearly the same values of this constant.

532.7

19129 PROPAGATION VELOCITY OF FINITE AMPLITUDE ULTRASONIC WAVES IN A LIQUID.

L.K.Zarembo and V.V.Shklovskaya-Kordi.

Akust. Zh., Vol. 6, No. 1, 47-51 (1960). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 6, No. 1, 42-6 (July-Sept., 1960).

In a solution of methyl alcohol and water, with a temperature-velocity coefficient of $\sim 10^{-6}$ deg^{-1}, the change in the velocity was determined for the zeros of a wave of finite amplitude with an increase in the potential on the radiating quartz from 100 V to 1.5 kV at a frequency of 1.5 Mc/s. The maximum accuracy of the determination of change in velocity was 0.003%. Measurements with a constant surplus pressure (~1 atm), when the initiation of cavitation is impeded, showed that with an accuracy of ~0.007% the velocity of a finite-amplitude zero-order wave (with acoustic Reynolds numbers ~10 and Mach numbers $\sim 10^{-4}$) remained constant. With the initiation of cavitation in water in the solution a very large discontinuous jump in the velocity was observed over a certain interval of propagation of the wave.

532.7 : 534.22

19130 RELATIONSHIP BETWEEN ULTRASONIC VELOCITY AND OTHER PHYSICAL PROPERTIES OF PURE ORGANIC LIQUIDS. S.C.Srivastava.

Indian J. Phys., Vol. 33, No. 11, 503-4 (Nov., 1959).

The author suggests an empirical relationship for organic liquids, between ultrasonic velocity V, molar refraction R, and internal pressure (related to boiling point) P. Many values of velocity fit

$$V\rho^{1/2} = kR^{1/2}P$$

where $k = 7 \mp 1$. Several others give a value of k "beyond the desired value". V.J.Hamm

52.

19131 THE PROPAGATION OF SOUND IN A BINARY LIQU MIXTURE. A.E.Brown and E.G.Richardson.

Phil. Mag. (Eighth Ser.), Vol. 4, 705-20 (June, 1959).

Measurements were made in mixtures of aniline and cyclohexane at various concentrations and temperatures in the vicinit of the solution point of the velocity and attenuation of ultrasonic pulses. It appears that the large values of the attenuation obser in this region are due to the scattering of the radiation, which w measured as to its angular distribution at various frequencies. Evidence from the extinction and directionality of sound signals the mixture shows that the scattering is due to biphasal clusters which exist in the neighbourhood of the solution point and which a not set up by the passage of the sound itself. There remains som absorption which is of a molecular (viscous) nature.

532.7 : 53

19132 MEASUREMENT OF THE VELOCITY OF SOUND IN LIQUID ARGON AND LIQUID NITROGEN AT HIGH PRESSURES. E.R.Dobbs and L.Finegold.

J. Acoust. Soc. Amer., Vol. 32, No. 10, 1215-20 (Oct., 1960).

An ultrasonic interferometer, consisting of a barium titanat ceramic cylinder suspended in a high-pressure vessel, has been used to measure the velocity of sound in liquid argon and liquid nitrogen at temperatures near their boiling points and at pressur up to 135 atm. The apparatus is suitable for measurements at much higher pressures, since it is rugged, compact, and has no moving parts. An analysis of the resonances obtained over a fre quency range 0.2 f_0 to 1.7 f_0 (where f_0 is the thickness resonant frequency of the ceramic cylinder) has shown that a simple relati exists between the velocity in the liquid and the zeros of the Bess functions J_0 and J_1 for frequencies near 0.5 f_0 and 1.5 f_0. The velocity data obtained agree with previous measurements on liqui argon and liquid nitrogen at atmospheric pressure, but show that the velocity of sound in these liquids is not a linear function of pressure, as had been supposed by Itterbeek. Using known densit data, the adiabatic compressibility and ratio of the specific heats have been found for liquid argon and liquid nitrogen at 90°K. For argon, γ falls slightly from 1.97 to 1.89 as the pressure rises to 135 atm, but for nitrogen γ rises from 1.50 to 1.79 with the applie pressure, suggesting the hindering of intramolecular motions at t higher pressures.

532.7 : 534.

19133 MOLAR SOUND VELOCITY IN INORGANIC ACIDS. P.R.K.L.Padmini, K.Subba Rao and B.Ramachandra Ra

J. chem. Phys., Vol. 33, No. 4, 1268-9 (Oct., 1960).

Data on molar sound velocity in aqueous solutions of sulphuri nitric, phosphoric, and perchloric acids at various concentrations are given and compared with values computed using an empirical atomic-increments method. G.I.W.Llewe

532.7 : 534

19134 STUDY OF MOLAR SOUND VELOCITY IN LIQUIDS. P.R.K.L.Padmini, K.Subba Rao and B.Ramachandra R

Trans Faraday Soc., Vol. 56, Pt 10, 1404-8 (Oct., 1960).

A study of a number of six- and five-membered ring compou revealed positive contribution to molar sound velocity due to thes ring structures. From a study of about ten liquids containing semipolar bonds, it is shown that this type of linkage contributes a negative value of −25 to the molar sound velocity. Molar sound velocity increments for several atoms and bonds for which the da are not available are reported.

532.7 : 534

19135 ULTRASONIC ATTENUATION IN THE CRITICAL REGION. M.Fixman.

J. chem. Phys., Vol. 33, No. 5, 1363-70 (Nov., 1960).

The interaction of forced sound waves with critical density fluctuations is discussed quantitatively. The nonlinear equations motion are analysed to distinguish three contributions to the insta taneous density and temperature variation: (1) the spontaneous fluctuations that are defined as the solution to an initial value problem, (2) the macroscopically observed sound wave which oscillates with harmonic time dependence, and (3) the result of an interaction between (1) and (2). The three contributions satisfy e equations, which are discussed separately. A completely ral combination of these equations to compute ultrasonic absorp- and attenuation is avoided, as the requisite thermodynamic and sport coefficients are inadequately known. Because, however, rmal relaxation mechanism has previously been treated on the s of an oversimplified multiphase picture of spontaneous fluctu- ıs, the present calculations are carried to completion on the mption that only the local heat capacity is affected by the density uations. The sound wave together with the fluctuating heat city produce temperature fluctuations, whose relaxation is the ce of the absorption.

532.7 : 537.2

19136 INFLUENCE OF WATER ON THE CONDUCTIVITY OF DIELECTRIC LIQUIDS. N.Félici.

. Acad. Sci. (Paris), Vol. 250, No. 24, 3960-2 (June 13, 1960). rench.

It is shown that simple theories based on the law of Mass Action n the assumption that dissociation is solely dependent on the nittivity of the solvent are not sufficient to explain the conduct- , due to impurity water, found in organic liquids. It is suggested the solution is not homogeneous in the neighbourhood of an ion, is, that an ion is surrounded by pure water and concentrated ition. R.G.C.Arridge

532.7 : 537.2

19137 DETERMINATION OF DIELECTRIC CONSTANT IN BINARY ORGANIC SYSTEMS. C.G.Miller and O.Maass.

ad. J. Chem., Vol. 38, No. 9, 1606-16 (Sept., 1960).

Measurements of the dielectric constants of binary systems e made using hexane, benzene, toluene, acetone, isopropyl ohol, and nitrobenzene two at a time. It was the purpose to obtain urate data for the dielectric constants for the 15 systems over whole range of concentrations from 0 to 100%, with the absolute uracy of 0.1%. It is claimed that the relative accuracy is of this er. From the data obtained regularities have been found which expressed in the form of empirical equations which summarize data. Tentative suggestions regarding theoretical conclusions made in a number of cases.

532.7 : 537.2

19138 TEMPERATURE VARIATION OF DIELECTRIC RELAXATION IN SIX POLAR LIQUIDS. J.Sobhanadri.

ian J. Phys., Vol. 33, No. 12, 511-19 (Dec., 1959).

Six polar molecules in dilute solution using n-heptane as vent over the temperature range 0°C to 80°C were studied. The lecules investigated were chloro-benzene, o-chloro-toluene, dichloro-toluene, methyl n-butyl ketone, methyl n-amyl ketone methyl phenyl ketone (acetophenone). The energy of activation dipole relaxation for each liquid is compared with the corres- ding value for viscous flow. The results are examined in the nt of Eyring's theory of absolute reaction rates.

532.7 : 537.2

19139 DIELECTRIC RELAXATION IN LIQUID ALCOHOLS, ALKYL HALIDES AND SOLUTIONS.

Kh.Koyl [R.H.Cole].

Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 1, 4-9; Disc. 32-5 60). In Russian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 0). A brief review of the author's dielectric measurements on ss-forming liquids at low temperatures such as 1-butanol, ropanol and isobutyl chloride and some solutions of these. The icle summarizes the work referred to in the references to the er, almost all of which are in English. J.G.Powles

532.7 : 537.2

19140 DIELECTRIC POLARIZATION OF SOME ALIPHATIC ALCOHOLS. M.Maga[Magat] and K.Bro[C. Brot].

. Akad. Nauk SSSR, Ser fiz., Vol. 24, No. 1, 10-18; Disc. 32-4 60). In Russian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 0). Bauer [Cahiers de Phys., Vol. 1, Nos. 20-1 (1944)] assumed t the very substantial difference between the critical frequencies water and ice (although the structural environments of both ses do not differ very much) can be explained by the fact that the chanisms underlying dielectric dispersion are different, a long- ge order existing possibly in ice, but being absent in water. s theory is borne out by research on liquids in which hydrogen bonds play an important role: aliphatic alcohols from C_3 to C_{10}. The three relaxation regions (metre, decimetre and centimetre regions) involved are discussed in detail and interpreted, a model of liquid alcohols is put forward and the kinetics of the formation of complexes is analysed. F.Lachman

532.7 : 537.2

19141 DIELECTRIC CONSTANT OF DIELECTRIC LIQUIDS IN STRONG ELECTRIC FIELDS. A.Pekara. [Piekara].

Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 1, 19-24, Disc. 32-5 (1960). In Russian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 1960). A brief review of work on dielectric constants of liquids and solutions in high electric fields. The case of nitrobenzene is discussed in detail. In solutions of polar molecules in non-polar solvents, there are three types of dependence on concentration and the reasons for this are discussed. The effect of internal molecular flexibility in multi-dipolar molecules is discussed. (Only one of the articles cited in this bibliography is in Russian). J.G.Powles

532.7 : 537.2

19142 DIELECTRIC POLARIZATION, SIZE AND FORM OF MOLECULES. Ch.F.Smais [C.P.Smyth].

Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 1, 25-31; Disc. 32-5 (1960). In Russian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 1960). A summary is given of recent work at Princeton. The macroscopic and microscopic relaxation times, the viscosities, permittivities, and dielectric losses of a number of organic liquids are tabulated and discussed in relation to the molecular structure and intermolecular forces. R.F.S.Hearmon

532.7 : 537.2

19143 DIELECTRIC RELAXATION OF POLAR LIQUIDS. S.H.Glarum.

J. chem. Phys., Vol. 33, No. 5, 1371-5 (Nov., 1960).

The statistical theory of the dielectric relaxation of polar liquids is developed using the fluctuation-dissipation approach to linear dissipative phenomena, and an expression is derived relating the complex dielectric constant to a time-dependent microscopic correlation function. It is found that a finite number of microscopic relaxation times leads to an equal number of macroscopic decay times, and, in the case of a single relaxation time τ_0, the decay time is given by

$$T_0 = [3\epsilon_0/(2\epsilon_0 + \epsilon_\infty)]\tau_0,$$

ϵ_0 being the static dielectric constant, and ϵ_∞ being the high frequency dielectric constant. Relaxation times are also determined for systems having two decay times, and for systems characterized by the circular-arc and skewed-arc distribution functions.

532.7 : 537.2

19144 RELAXATION TIMES OF SOME ALCOHOLS AND ESTERS. B.L.Narayana.

J. sci. industr. Res., Vol. 18B, No. 7, 304 (July, 1960).

Reports the results of measurements made on the dielectric properties of certain alcohols and esters studied at 3.26 cm. in solution in benzene at 28° C., using a waveguide set-up and the standing wave method of Roberts and von Hippel.

532.7 : 537.2

19145 DIELECTRIC RELAXATION IN RELATION TO VISCOSITY. J.Sobhanadri.

J. sci. industr. Res., Vol. 18B, No. 12, 508-11 (Dec., 1959).

The relaxation times of butyl stearate, ethyl phthalate, p-chlorotoluene, ethyl adipate and iodobenzene were determined at different solvent viscosities using benzene—paraffin mixtures. An explanation for the variation in the apparent value of the dipole moment with viscosity is suggested.

532.7 : 537.2

19146 EFFECT OF THE DIPOLAR ROTATION OF LIQUIDS. III. E.Grossetti.

Nuovo Cimento, Vol. 18, No. 1, 21-31 (Oct. 1, 1960).

For Pt II, see Abstr. 12228 of 1959. The rotational momentum values for some polar liquids (toluene, nitrobenzene, ethyl alcohol, amyl alcohol, distilled water, acetic acid) in a rotating electric field, at 100.0, 120.0 and 150.0 Mc/s, were measured in order to determine in a different way the viscosity coefficient values.

The values of the viscosity coefficient, η, obtained by comparing the experimental rotational momentum with that given by the Born formula — in which M is substituted by the values of the electric momentum measured in the Debye polarization processes — are relatively in agreement with those obtained by classical methods.

532.7 : 537.2 : 539.2

19147 DIELECTRIC BEHAVIOUR OF TWO PHASE MIXTURES.

T.Naiko, K.Fujita and S.Matsumara.

Mem. Fac. Industr. Arts Kyoto Tech. Univ. (Sci. Technol.), No. 8, 1-19 (1959).

The permittivity ϵ at 2 Mc/s of various water—oil emulsions, mercury—vaseline mixtures, and packed glass balls is shown to be in good agreement with Bruggeman's formula

$$(\epsilon-\epsilon_2)/(\epsilon_1-\epsilon_2)=(1-\varphi)(\epsilon/\epsilon_1)^{1/3},$$

where ϵ_1 and ϵ_2 are the permittivities of the disperse phase and continuous medium respectively, and of the volume fraction of the continuous phase. Bruggeman's formula also predicts the effect of changing temperature on ϵ of NH_4I powder dispersed in ethyl ether, (Abstr. 833 of 1936). J.H.Mason

532.7 : 537.2 : 621.315.615

19148 SPACE CHARGES IN LIQUID DIELECTRICS.

Z.Croitoru.

Bull. Soc. Franc. Elect. (Ser. 8), Vol. 1, No. 6, 362-80 (June, 1960). In French.

Conduction phenomena in dielectrics differ markedly from those in metals, since the presence of local or general space charges results in a non-uniform distribution of electric field. Several methods of measurement of the electric field are described. An optical method using the Kerr electric birefringence enables the electric field to be measured at all points of the dielectric immediately after the application of the potential, or with a certain time-lag. The application of the method to chlorobenzene has shown the existence of important space charges which form mainly at the electrode contacts. Several theoretical and practical results of this are discussed. J.B.Birks

532.7 : 537.2 : 539.2

SOME DIELECTRIC INVESTIGATIONS AT 3.15 cm AND 8.7 mm BANDS. See Abstr. 18090

532.7 : 537.2 : 539.19

19149 MICROWAVE ABSORPTION OF DIPHENYL COMPOUNDS IN DILUTE SOLUTION.

F.Hufnagel.

Z. Naturforsch., Vol. 15a, No. 8, 723-8 (Aug., 1960). In German.

Absorption measurements are made for a series of molecules in solutions of strength 0.3-4.0 mole % in benzene, carbon tetrachloride and heptane, at wavelengths of 15 and 7 mm. Absorption maxima are located from these and existing data. Diphenyl ether, diphenyl sulphide and diphenyl selenide show abnormally short relaxation times and departures from the Debye theory. A tentative analysis is given using a combination of Debye- and Fröhlich-terms. All relaxation times depend strongly on the viscosity of the solvent. In contrast, molecules which may reasonably be regarded as rigid obey the Debye theory and show relaxation times of the magnitude expected from their volume and form. This is also found for substances in which two phenyl groups are joined by structures such as —CO—, $-CH_2-S-CH_2$, —S—S—, —SO— and $-SO_2-$. It is concluded that the rapid reorientation mechanism of the molecular dipole in diphenyl ether, sulphide and selenide is essentially connected with the direct attachment, to both phenyl rings, of one atom which possesses two unshared electron pairs in its valency shell. J.Sheridan

532.7 : 537.3

19150 ON ELECTRIC CURRENTS IN LIQUID MERCURY, ARISING FROM DIFFUSION OF CONDUCTION ELECTRONS.

F.Cammerer.

Z. Phys., Vol. 160, No. 2, 219-32 (1960). In German.

Experiments on plasma phenomena in liquid mercury are described and discussed. A current arises from the difference in ranges of free holes and electrons. The range of the electrons is found to be 2% greater than that of the holes. The Hall constant of liquid mercury is found to be -6.3×10^{-12} m^3 amp^{-1} sec^{-1}. C.A.Hogarth

532.7 : 537.1

19151 A STUDY OF THE PHOTOCONDUCTIVITY OF ETHE SOLUTIONS.

Yu.A.Kopўlov.

Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 2, 237-41; Disc. 242 (1960). In Russian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 1960). The results of measurements on halogen derivatives of so hydrocarbons dissolved in diethyl ether are analysed in terms of molecular, ionic, metastable, etc. levels. There is an analogy wi solid semiconductors in properties which depend on the number o carriers, e.g. (1) exponential relaxation processes, (2) maximum conductivity near the long wavelength absorption limit, (3) a defi value of the dielectric constant is necessary for photoconductivity (4) the current is linear with field and illumination, (5) the photoconductivity of a binary mixture has a maximum. Properties due mobility, related to long-range order, differ, e.g., a positive temperature coefficient of photoconductivity. R.Berm

532.

19152 A STATISTICAL MOLECULAR THEORY OF ELECTRIC, MAGNETIC AND OPTICAL SATURATION PHENOMENA IN ISOTROPIC DIELECTRIC AND DIAMAGNETIC MEDIA.

S.Kielich and A.Piekara.

Acta phys. Polon., Vol. 18, No. 5, 439-71 (1959).

Presents a general discussion of the nine possible saturation effects (electric, magnetic or optical polarization made non-linear by strong electric, magnetic or optical fields), the approach being an extension of that used in Abstr. 4343 of 1959 to discuss, for axially symmetric molecules, five of these effects. It is shown how to relate the six unknown effects to the three that have been found experimentally, and the nine constants of nitrobenzene are computed. J.Hawgood

532.7 : 535 : 539

19153 THE REFRACTIVE INDICES OF LIQUID AND SOLID ARGON.

G.O.Jones and B.L.Smith.

Phil. Mag. (Eighth Ser.), Vol. 5, 355-8 (April, 1960).

The refractive indices of liquid and solid argon were measured as a function of temperature between 74° and 95°K. The results, represented by the Lorentz—Lorenz function, are expressed as a function of density, and their significance discussed.

532.

19154 INFRA-RED MEASUREMENTS OF THE OPTICAL CONSTANTS OF LIQUID SILVER.

J.N.Hodgson.

Phil. Mag. (Eighth Ser.), Vol. 5, 272-7 (March, 1960).

The optical constants of liquid silver was measured in the infra-red between wave numbers 4000 and 17 000 cm^{-1}. The result are compared with the Drude theory and lead to a value of about 1. for the effective number of free electrons per atom. The electrica conductivity of the surface layer, calculated from optical constants differs by less than 10% from the bulk conductivity. Some results on the temperature variation of the optical constants are presented The optical constants of liquid copper was also measured at two wave numbers in the infra-red.

532.7 : 535.3

19155 ABSORPTION SPECTRA OF MOLTEN FLUORIDE SALTS. SOLUTIONS OF SEVERAL METAL IONS IN MOLTEN LITHIUM FLUORIDE—SODIUM FLUORIDE—POTASSIUM FLUORIDE.

J.P.Young and J.C.White.

Analyt. Chem., Vol. 32, No. 7, 799-802 (June, 1960).

Spectra are presented for nickel fluoride, cobalt fluoride, chromic fluoride, praseodymium fluoride, uranium tetrafluoride, a uranyl fluoride dissolved in molten lithium fluoride—sodium fluoride—potassium fluoride at temperatures ranging from 500° to approximately 650°C. These spectra are compared to similar spe tra obtained in other molten salts and aqueous solutions. General procedures are described which were used in preparing the fluorid salt melt and in recording the spectra by means of a high-tempera ture cell assembly designed for use with a Cary recording spectro photometer, Model 14M.

532.7 : 535.

19156 STUDY OF THE DIFFUSION SPECTRUM OF NICKEL CARBONYL IN THE LIQUID STATE AND IN SOLUTIO

M.Bigorgne.

C.R. Acad. Sci. (Paris), Vol. 251, No. 3, 355-7 (July 18, 1960). In French.

The Raman spectra of superfused liquid Ni(CO)$_4$ at –28° C and
lution in pentane at –55° C are presented and briefly discussed.
ılso Abstr. 19218. G.I.W.Llewelyn

532.7

157
ON THE ABSORPTION OF 3.18 CM MICROWAVES IN ETHYLENE CHLORHYDRIN AND ITS SOLUTIONS.

Bhattacharyya.
ın J. Phys., Vol. 33, No. 11, 498-582 (Nov., 1959).
The absorption of microwaves of length 3.18 cm in pure
lene chlorhydrin and its solutions in carbon tetrachloride and
ıyl cyclohexane have been studied in the temperature range
ı –70° C to 115° C, from –50° C to 80° C and from –80° C to
respectively. In the case of the pure liquid the absorption
ts at –40° C and increases rapidly with rise of temperature
out showing any tendency to remain constant. In the case of
solution in CCl$_4$ absorption has been found throughout the
perature range from –50° C to 80° C with a maximum value at
. In the case of solution in methyl cyclohexane the absorption
ıuch feebler. It starts at –20° C and gradually increases with
rise of temperature but much less rapidly than in the case of
pure substance. The results have been explained on the
ımption that the pure liquid consists of dimers formed through
types of intermolecular hydrogen bonds, one through O - H ...O
the other through O - H ... Cl linkage.

532.7 : 535.37

19158
THE ORIGIN OF LUMINESCENCE OF LIQUIDS UNDER THE ACTION OF HARD RADIATIONS.

Al'perovich, I.D.Sherbaf and R.Marupov.
ika i Spektrosk., Vol. 8, No. 2, 259-61 (Feb., 1960). In Russian.
Solutions of anthracene, naphthalene, β-naphthylamine,
nanthrene and stilbene in xylene, benzene, toluene and dioxane
e excited with X-rays from a 30-200 kV tube and with Co^{60}
ays. The intensities of X- and γ-luminescence were similar.
and γ-excited luminescence of pure solvents (xylene, toluene,
zene, dioxane, CCl$_4$, methyl alcohol and water) was also studied.
as found that pure non-aromatic liquids emit practically no
inescence when irradiated with X-rays and their γ-luminescence
lue to Vavilov—Cherenkov radiation. In pure aromatic liquids
h luminescence and Vavilov—Cherenkov radiation were produced
ether. A.Tybulewicz

532.7 : 535.37

19159
ENERGY TRANSFER AND DECAY TIMES IN RADIATION-INDUCED LUMINESCENCE OF BENZENE LUTIONS.

M.Burton and H.Dreeskamp.
Elektrochem., Vol. 64, No. 1, 165-9 (1960).
A previously described technique (Abstr. 5555 of 1959) for the
ecise measurement of luminescence decay times in the range
ound 10^{-9} sec, has been slightly modified so as to permit more
act interpretation of the data. The results for a system of aerated
nzene containing p-terphenyl scintillator have been analysed to
licate two decay times, τ_1 and τ_2 as governing parameters of the
ape of the luminescence decay curves. The value of τ_1 is a vari-
le nonlinear function of scintillator concentration and is assigned
the excited state of the solvent. In absence of scintillator τ_1 for
excited benzene is ~2 × 10^{-8} sec. The value of τ_2 is fixed at
× 10^{-9} sec and appears assignable to the excited state of the
intillator. However, certain anomalies raise questions as to the
opriety of such assignment.

532.7 : 535.37 : 539.1.07

19160
SCINTILLATION IN NOBLE GASES AND THEIR MIXTURES.

L.Koch.
clear Electronics Conference, Paris, 1958. Vol. I. (see Abstr.
719 of 1960) 151-62. In French.
A substantial part of the energy of a charged particle traversing
ıoble gas is re-emitted in the form of photons. The results of
easurements of pulse amplitude for different concentrations of
in helium and argon are given. In He the maximum is obtained
0.001% and in A at 5%. The number of photoelectrons, δ,
itted when an α particle of 5 MeV is absorbed varies from 400 in
non to 1200 in He + 0.001% N$_2$ (for thallium-activated NaI,
4000). The pulse shapes are illustrated, and decay time
nstants are tabulated for various gases and impurity concentrations
mes of luminescence shorter than 10^{-8} were obtained only with
gon. The reasons for failure to confirm the theoretical law of
long time constant may be due to lack of sensitivity of the
apparatus or to the fact that the wavelength is too short to be detected by the quartz optical system. An experiment was also performed to determine the contribution to the luminescence of recombination of ions. If the ions formed are collected, a diminution of output should be observed. An earlier worker had found no variation, and in the author's experiments, again, no variation was detectable if the field strength was less than 100 V/cm, but above this value increasing signals were observed, the gain factor being 60 at 600 V/cm. Either the wavelengths of the emission due to recombination were outside the spectral limits observed (2500-6000A) or the expected effect was masked by the excitation of atoms by accelerated electrons in the electric field. The excellent linearity (proportionality to energy) of gas scintillators and the short duration of the luminescence, enable them to be used, with high-gain photo-multipliers, to drive coincidence circuits etc., directly. W.G.Stripp

532.7 : 535.37

19161
EFFICIENCY OF ENERGY TRANSFER IN A SOLUTION OF PPO IN XYLENE.

I.B.Berlman.
J. chem. Phys., Vol. 33, No. 4, 1124-7 (Oct., 1960).

The nonradiative energy transfer of an organic scintillating solution as a function of the solute concentration has been determined by three independent methods: namely, direct measurements of the fluorescent lifetime, the light output of the solvent, and the light output of the solute. The efficiency of energy transfer ranges from 12% at 0.02 g/litre, to 92% at 2 g/litre of PPO (diphenyloxazole) in xylene. The results from the three methods agree within a few percent.

532.7 : 535.37

19162
CHARGE TRANSFER AND FLUORESCENCE QUENCHING.

D.K.Majumdar and S.Basu.
J. chem. Phys., Vol. 33, No. 4, 1199-1201 (Oct., 1960).

A charge-transfer-interaction mechanism is proposed for the quenching of fluorescence of a number of polynuclear aromatic hydrocarbons by aromatic solvents, especially methylated benzenes. The quenching efficiency was found to be in the order benzene < toluene < < xylene < mesitylene, which is also the order in which ionization energy of the solvents diminishes.

532.7 : 535.37 : 535.8

MEASUREMENT OF THE EMISSION ANISOTROPY OF FLUORESCENT SOLUTIONS. See Abstr. 19394

532.7 : 535.37 : 539.2

MEASUREMENT OF LUMINESCENCE DECAY IN THE REGION 10^{-8}-10^{-4} SEC FOR OPTICAL EXCITATION. See Abstr. 18134

532.7

19163
SONOLUMINESCENCE: A DISCUSSION.

P.Jarman.
J. Acoust. Soc. Amer., Vol. 32, No. 11, 1459-62 (Nov., 1960).

A brief summary of existing knowledge about sonoluminescence is given. Various theories of the origin of this luminescence are discussed. The author concludes that sonoluminescence is basically thermal in origin and that it might possibly arise from microshocks with the collapsing cavities.

532.7 : 535.37

19164
ULTRASONIC LUMINESCENCE: A SURVEY.

I.E.Él'piner.
Akust. Zh., Vol. 6, No. 1, 3-15 (1960). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 6, No. 1, 1-12 (July-Sept., 1960).

The phenomenon of luminescence of liquids in a field of ultrasonic waves, first observed in 1935, has become the object of extensive investigations. The importance of these investigations is contained in the fact that luminescence in liquids usually takes place under those conditions of sound irradiation for which the initiation of chemical and physico-chemical reactions becomes inevitable. The present survey covers 53 papers published between 1935 and 1959.

532.7 : 538.2

19165
THE MAGNETIC EFFECT OF DISSOLVED OXYGEN IN DIAMAGNETIC LIQUIDS.

C.O.L.Juulman.
Z. Phys., Vol. 160, No. 1, 109-20 (1960). In German.

A study of the diamagnetic susceptibility, using the Gouy method, of water, benzene and nitrobenzene for various partial pressures of oxygen and air. A disagreement with values calculated from the solubility is found for water and benzene. It is pointed out that air saturated water, benzene and nitrobenzene at 20°C differ in susceptibility from the oxygen free liquids by 1.0, 7.6 and 5.2%, respectively. It is suggested that the air saturated liquids should be used as reference substances. J.G.Powles

532.7 : 538.27

19166 STUDY OF SEGMENTAL MOTION IN POLYMER SOLUTIONS BY NUCLEAR MAGNETIC RESONANCE.
A.Odajima.
J. Phys. Soc. Japan, Vol. 14, No. 6, 777-91 (June, 1959).

Using a high resolution type n.m.r. spectrometer it was verified that the line widths of the phenyl and CH_2 groups in polystyrene—CCl_4 solutions were almost all independent of chain lengths in dilute solutions These values of line widths indicate that the so-called segmental motion in a chain is performed in the unit of about ten monomers. Segmental motion hindered by the potential field was discussed using the generalized theory of Brownian motion The influences of restricted motion upon T_1 and T_2 in polyisobutylene—CCl_4 solution were examined. The results of the theory are as follows: the activation energy of segmental motion tends to the activation energy of the solvent when the concentration of polymer decreases. The value of activation energy increases with the increase of concentration of polymer. These results are in a good agreement with those of mechanical and dielectric measurements. Furthermore, the values of hindering potential are calculated from the data of T_1 and T_2 in PIB solutions Finally, it is verified that the rigidity of polymer solutions in the high frequency measurements are caused by the potential field hindering the micro-Brownian motion of segments.

532.7 : 538.27

19167 PARAMAGNETIC RELAXATION IN SOLUTIONS OF VO^{++}. R.N.Rogers and G.E.Pake.
J. chem. Phys., Vol. 33, No. 4, 1107-11 (Oct., 1960).

The e.s.r. spectrum of vanadyl ion in solutions has the interesting feature that the linewidths of the individual hyperfine components depend on the nuclear spin orientation, m_I. The authors have determined that the origin of the effect is the mechanism proposed by McConnell, namely, the existence of a "microcrystal" about the VO^{++} ion which gives rise to anisotropies in the g tensor and hyperfine interaction. By comparing the results of linewidth measurements made at 9.25 kMc/s and 24.3 kMc/s with the results of calculations made by Kivelson, the validity of the microcrystallite model is determined.

532.7 : 538.27

19168 Cl^{35} N.M.R. CONTACT SHIFTS IN AQUEOUS COBALTOUS CHLORIDE SOLUTIONS. D.B.Chesnut.
J. chem. Phys., Vol. 33, No. 4, 1234-7 (Oct., 1960).

The n.m.r. shifts of the Cl^{35} nucleus in aqueous cobaltous chloride solutions were measured relative to the free chloride ion. The displacement of the Cl^{35} resonance to lower applied fields at constant frequency becomes larger with both increasing cobaltous and chloride ion concentrations. The effect of added non-complexing salt indicates the significant role hydration plays in the complex equilibria taking place. The magnitudes of the observed shifts point to an isotropic electron-spin—nuclear-spin contact interaction in the complexed cobaltous chloride.

532.7 : 538.27

19169 DIPOLAR BROADENING OF N.M.R.LINES IN LIQUIDS. J.Seiden.
J. Phys. Radium, Vol. 20, No. 12, 982-3 (Dec., 1959). In French.

Measurements have shown that for many liquids of very low viscosity $T_2 < T_1$, where theoretically T_2 should equal T_1. One possible cause of this is the presence of local anisotropies. Three possible sources of such anisotropies are discussed and the effect of each considered. S.A.Ahern

532.7 : 538.27

19170 AN ABNORMAL SATURATION BEHAVIOUR IN HIGH RESOLUTION PROTON MAGNETIC RESONANCE SPECTRA. M.Nagumo and Y.Kakiuchi.
J. Phys. Soc. Japan, Vol. 14, No. 5, 679 (May, 1959).

A remarkable anomaly in saturation behaviour is observed in the spectra of some benzene substituents. The apparatus used was a Varian V 4300 spectrometer at 40 Mc/s, and the measurements were conducted at room temperature. The magnetic field was se slowly as usual. No saturation was observed under a moderate f field when the magnetic field was swept from lower to higher va whereas a decrease of the signal intensity as a whole as well as distortion of the line shape appears when the field was swept fro higher to lower values. This phenomenon becomes the more co spicuous, the stronger H_1, the intensity of the r.f. field and the slower the rate of the sweep through the solute signal as is natu expected, but is quite independent of the H_1 while the field is swe through the solvent signal. The choice of solvent is immaterial s far as it contains protons, and its proton resonance line appears high-field side with respect to that of the solute. On the other ha concentrated solutions or with solvent which contains no protons carbon tetrachloride for example, such an asymmetry in the tota area of the signal for the forward and reversed sweep directions d not appear. Similar phenomena were also found in many other s stances; e.g. aniline, pyridine, p-nitrochlorobenzene, etc., which have at least two kinds of non-equivalent ring protons as is the c in nitrobenzene, thus forming multiplet spectra, whereas in benz or monochlorobenzene whose spectra consist of almost a single l such an anomaly was not observed. This abnormal saturation behaviour occurs irrespective of the relative positions of each p group with respect to the substitute groups.

532.7 : 54

19171 THE ADIABATIC THEORY OF ELECTRON [TRANSFER] PROCESSES IN SOLUTIONS.
V.G.Levich and R.R.Dogonadze.
Dokl. Akad. Nauk SSSR, Vol. 133, No. 1, 158-61 (July 1, 1960).
In Russian.

Oxidation—reduction reactions in solutions are considered i the light of contemporary electron-transfer theories, applying adiabatic approximations. The probability of electron transfer between similarly charged ions, at low and high temperatures, a the effects of various factors, such as free energy of activation, entropy of activation, specific polarization, time and distance between reacting ions, are discussed. A.Av

MECHANICS OF GASES

53

19172 INTERACTION BETWEEN A RIGID BODY AND A FR MOLECULE FLOW. I. ENERGY EXCHANGES.
II. MOMENTUM EXCHANGES. S.Nocilla.
Atti Accad. Sci. Torino I, Vol. 94, No. 4a, 445-72; No. 5a, 595-62 (1959-60). In Italian.

533.6 : 53

19173 ON THE CONDUCTANCE OF SYSTEMS FOR MOLECULAR FLOW OF GASES. N.A.Florescu.
Vide, Vol. 15, 197-209 (May-June, 1960). In French and English.

It is claimed that the molecular flow conductance of systems ducts has not been properly understood and that this has led to fallacious results. Ducts of circular cross-section are considere in terms of entrance conductances and tube conductances. When deducing the conductance of a number of short circular tubes of equal radius in series by this method the combined conductance comes out to be equal to that of a single tube of equivalent length. A similar procedure based on the well-known Clausing coefficien for short tubes does not lead to this result. It is concluded that Clausing's work was in error while the procedure advocated is assumed to be correct. W.Steckelmac

53

19174 A CONTRIBUTION TO THE THEORY OF AXIALLY SYMMETRIC FLOW OF GASES. V.P.Karlikov.
Dokl. Akad. Nauk SSSR, Vol. 133, No. 5, 1049-52 (Aug. 11, 1960).
In Russian.

Considering adiabatic flow and neglecting dissipation the equations of motion of aerodynamics are formulated in terms of spherical polar coordinates, i.e. a radius vector and an angle. Solutions are obtained in the form of a series in powers of the radius vector. The coefficients depend upon the angle and time. Equations are obtained for the velocity, pressure and density alo the axis; another set of equations has the form of recurrence rel tions by means of which the higher coefficients of the series can derived. R.Eisensc

533.6

175 THE TRANSFER OF MOMENTUM ACROSS SURFACES
DRAWN PERPENDICULAR TO THE DIRECTION OF
V IN GASES UNDER LAMINAR CONDITIONS.
erif.
gew. Math. Phys., Vol. 8, No. 2, 165-7 (March 25, 1957).

533.6

176 THE DRAG OF LATTICE OF MANY PARALLEL
CIRCULAR CYLINDERS AT LOW REYNOLDS
BER. T.Sawada.
ys. Soc. Japan, Vol. 14, No. 6, 837-42 (June, 1959).
The relations between the drag coefficient C of the lattice of
parallel circular cylinders and Reynolds number R were
ed experimentally. The drag of the specimen falling in a tower
measured in the region of R = ~ 0.25 ~ 1.0. If C versus the R
e of a cylinder by Wieselsberger (1921) is used as standard,
rsus R relations of lattice are approximately the same as
elsberger's, when h/d = 250 and 125, with d being the diameter
e cylinder, and h the distance apart of the centres of the two
ders. Accordingly it is seen that Imai's formula (1957) on the
s of the combination of Stokes' and Oseen's approximations is
r than Tomotika and Aoi's formula on the basis of Oseen's. The
rsus R relations of the lattice, when h/d = 50, 25 and 12.5, are
ewhat similar to the Fujikawa C verus R curves of two parallel
ders.

533.6

9177 THE ANALOGY FOR THE SIMULTANEOUS EXCHANGE
OF QUANTITIES OF MOMENTUM, HEAT, AND MASS.
MOGENEOUS GASES. G.Jarre.
Accad. Sci. Torino I, Vol. 94, No. 4a, 432-44 (1959-60). In
an.
The author discusses the flow of a gas past a semi-infinite fixed
. The similarity between the equations governing momentum
energy transfer, both for laminar and turbulent flow, is noted;
this, together with published experimental data, a universal
tion between velocity and temperature is obtained. This relation
lves as parameters the boundary values and a number varying
1 for laminar to 0 for completely turbulent flow.
O.Penrose

533.6

19178 SEPARATION OF GAS MIXTURES IN LAMINAR
FLOW. J.Strnad.
ngew. Math. Phys., Vol. 11, No. 3, 245-6 (May 25, 1960). In
man.
The separation effect is calculated for flow through a cylindrical
with constant wall temperature.

533.6

9179 THE LAW OF ROTATION OF A POLYTROPIC GAS
SPHERE. V.V.Porfir'ev.
on. Zh., Vol. 36, No. 3, 546-8 (1959). In Russian. English
slation in: Soviet Astron.—AJ (New York), Vol. 3, No. 3, 531-2
., 1959).
It is shown that a rotating polytropic gas sphere, in the absence-
ternal friction and circulating currents, can be in equilibrium
if the rotation is rigid.

533.6

19180 UNIFORM RAPID DEFORMATION OF [THE PATTERN
OF] TURBULENCE IN GASES. V.A.Frost.
. Akad. Nauk SSSR, Vol. 133, No. 4, 773-6 (Aug. 1, 1960). In
sian.
If a gas flowing through a tube passes through a nozzle, or a zone
ombustion, or if, generally, its speed, temperature or density
ergo rapid changes, this process is accompanied by a change
he pattern of flow. The corresponding change in turbulent flow
be specified in terms of the change in the average of the trans-
se speed of the gas. Provided that the transition is sufficiently
upt, its effect can be estimated by employing the conservation
of vorticity. In this way an elementary theory is developed
ch may be expected to apply best to supersonic or near-sonic
. The calculated changes in the transverse speed are compared
a number of experimental results. Agreement is sometimes
d, sometimes tolerable. R.Eisenschitz

533.6

19181 FRICTION AND HEAT EXCHANGE IN A COMPRESSIBLE TURBULENT BOUNDARY LAYER AT [THE SURFACE OF] A PLATE WITH MATTER BEING INJECTED. Yu.V.Lapin.
Zh. tekh. Fiz., Vol. 30, No. 8, 984-93 (Aug., 1960). In Russian.

Deals with the flow of a gas past a porous wall through which a different gas is admitted. The conventional theory of boundary layers is used. The transfer of momentum and energy to the wall is deduced and the result is discussed. R.Eisenschitz

533.6

19182 A POSSIBILITY OF INCREASING ROCKET THRUST. N.S.Kalitzin and G.S.Kalitzin.
C.R. Acad. Bulg. Sci., Vol. 13, No. 1, 11-14 (Jan.-Feb., 1960). In German.

The radiation temperature of the burning gases in the combustion chamber of a rocket is greatest along the axis and decreases towards the walls. The proposal is to cool the central region by injection of a gas (hydrogen is suggested) which removes heat by endothermic reaction. S.Weintroub

533.6 : 539.18

19183 INVERSION OF THE SEPARATION-JET UNMIXING [PROCESS] IN OVER-EXPANDED GAS JETS. K.Bier.
Z. Naturforsch. Vol. 15a, No. 8, 714-23 (Aug., 1960). In German.

The "normal" separation jet effect consists of an enrichment of the light component of a gas mixture in the outer zone near the nozzle of the freely expanding gas. This effect occurs in jets of both rotational-symmetrical and plane geometry. In rotational-symmetrical jets of sufficiently high density, one observes in addition, at a greater distance, an inverse separation, i.e. on enrichment of the lighter component at the centre. The present paper deals with an investiation of the variation in space of the separation at various gas pressures. It is shown that the inverse effect is mainly due to pressure diffusion in an inwardly directed pressure gradient which is caused by a compression shock.
H.London

533.6

19184 HIGH SUBSONIC FLOW WITH NORMAL SHOCK WAVE AT NEARLY CRITICAL MACH NUMBER. T.Sakurai.
J. Phys. Soc. Japan, Vol. 14, No. 5, 658-63 (May, 1959).

High subsonic flow past a biconvex circular arc aerofoil with a pair of normal shock waves at nearly critical Mach number is discussed by a very simple approximation procedure. The shock waves are assumed to be the normal shock waves which start from the surface of the aerofoil and stand perpendicularly to the direction of the uniform flow. The locations of the sonic line and the shock waves are treated as unknown parameters to be determined in the course of analysis. The results show that these parameters have real physical meaning only when the Mach number exceeds the usual critical Mach number calculated by means of Prandtl—Glauert approximation. The results also suggest that the curvature of the profile must change discontinuously at its intersection with the shock wave. This fact is also confirmed by applying Lin's exact consideration. Thus, it is concluded that there can exist no high subsonic flow of ideal fluid with normal shock waves starting from the surface past a profile having continuous curvature.

533.6

19185 THE POSSIBILITY OF NORMAL SHOCK WAVES ON A BODY WITH CONVEX SURFACES IN INVISCID TRANSONIC FLOW. G.E.Gadd.
Z. angew. Math. Phys., Vol. 11, No. 1, 51-8 (Jan. 25, 1960).

It is suggested that in steady inviscid transonic flow a shock wave can occur perpendicular to a body with a convex surface if the flow immediately downstream from the shock has a singularity similar to that caused by a discontinuity in the curvature of the surface. O.Penrose

533.6

19186 SUPERSONIC VISCOUS FLOW PAST A CONVEX CORNER. A.K.Roy.
Z. angew. Math. Phys., Vol. 10, No. 6, 592-603 (1959).

533.6

19187 EXPERIMENTAL STUDIES ON THE HYPERSONIC FLOW PAST PLANE, CONVEX AND CONCAVE WEDGES. C.S.Kim.

J. Phys. Soc. Japan, Vol. 14, No. 6, 827-37 (June, 1959).

The phenomena of viscous—inviscid interaction effects at $M_\infty = 6.2$ over the front part of bodies were investigated. The models tested were a flat plate and wedges having a plane, a convex or a concave surface, respectively. A uniform flow of $R_\infty = 2.0 \times \times 10^5$ per cm was established using a divergent shock tube. The measurements of the flow field were made by optical methods (interferometer and schlieren photograph), and in order to supplement the data the X-ray technique was employed near the leading edge of the model. The results are as follows. (1) For a flat plate: (i) the pressure distribution on the sharp-nosed plate is about 5% higher than the theoretical values of Nagakura and Naruse (Abstr. 7866 of 1959; (ii) the boundary layer thickness agrees almost perfectly with Naruse's theoretical values; (iii) the shock wave location is in good agreement with the empirical formulae of Kendall [Journal of Aeronautical Science, Vol. 24, 47 (1957)] and of Bogdonoff and Hammitt [Journal of Aeronautical Science, Vol. 23, 108 (1956)]. (2) For wedges: (i) near the leading edge, the boundary layer growth on a concave wedge is more rapid than that either on a plane or a convex wedge; (ii) except in the region close to the leading edge, the influence of leading edge bluntness on boundary layer growth is significant in the order of convex wedge, plane wedge and concave wedge; (iii) except in the region very close to the leading edge, the pressure distributions at the front parts of the plane and convex wedges are in fairly good agreement with the values predicted by inviscid theories (characteristic method, tangent-wedge approximation, Newtonian-plus-centrifugal-force approximation and hypersonic small disturbance theory), but considerable discrepancies are found at the rear parts; (iv) for the concave wedge, agreement is rather better at the rear part of the body than at its front part.

533.6 : 539.12

19188 FLASH X-RAY RADIOGRAPHY FOR THE DENSITY MEASUREMENT IN A HYPERSONIC AIR FLOW.

F.Tamaki and K.Chul-Soo.

J. Phys. Soc. Japan, Vol. 14, No. 5, 664-9 (May, 1959).

A soft X-ray radiograph method using a flash X-ray tube was developed as a means of measuring air density in a hypersonic flow in a shock tube. The method was applied to the measurement of the density distribution between a circular cylinder and the detached shock wave at a free-stream Mach number of 5.5 and a free-stream density of about one-tenth of the normal atmosphere. Results suggest that the method is promising for the investigation of hypersonic flow fields, especially for the measurement of narrow regions with steep density gradients, because the effect of refraction can be neglected without error in the wavelength range of X-rays.

533.6

19189 ELECTROMAGNETIC PUMP FOR CIRCULATING GASES AT LOW FLOW RATES. C.J.Sterner.

Rev. sci. Instrum., Vol. 31, No. 10, 1159-60 (Oct., 1960).

533.6 : 532.5

PRECISE TRACER MEASUREMENTS OF GAS FLOWS.

See Abstr. 19080

GASEOUS STATE

533.7

19190 A CASE OF GAS DYNAMICS.

A.B.Datzeff.

C.R. Acad. Bulg. Sci., Vol. 12, No. 2, 105-8 (March-April, 1960). In German.

The distribution of molecules in a rectangular plane has been calculated on the assumption that the molecules are reflected from the boundaries, and that there is no interaction when they collide with each other. R.Schnurmann

533.7

19191 PROPERTIES OF THE LINEARIZED COLLISION OPERATORS. STUDY OF THE GENERAL CASE.

J.Naze.

C. R. Acad. Sci.(Paris), Vol. 251, No. 5, 651-3 (Aug. 1, 1960). In French.

Every eigenfunction of the linearized collision operators is shown to be the product of a spherical harmonic and an isotropic function of the velocity. The determination of the latter reduce an eigenvalue problem which is stated to have been solved only Maxwellian molecules (inverse fifth-power repulsion).

H.N.V.Tempe

5

19192 BRINGING THE RELATIVISTIC COLLISION INTEG INTO THE BOLTZMANN FORM. N.A.Chernikov.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 1, 84-7 (July 1, 1960). In Russian.

A relativistic generalization of Boltzmann's collision integra is derived, starting from the relativistic collision integral obtain previously by the author (Abstr. 9007 of 1957). It is verified that the former collision integral vanishes for a relativistic Maxwell distribution. O.Penr

533.7 : 539

19193 COLLISION TRAJECTORIES FOR INVERSE POWER INTERMOLECULAR POTENTIALS. H.M.Mott-Smith

Phys. of Fluids, Vol. 3, No. 5, 721-4 (Sept.-Oct., 1960).

If $-cr^{-n}$ is the intermolecular potential for separation r, b t classical collision parameter, μ the reduced mass, g the relative velocity before collision, and χ the angle of deflection of the relat velocity due to collision, it is found that

$$\chi = -\sum_{t=1}^{\infty} \frac{\Gamma(\frac{1}{2}nt + \frac{1}{2})\,\Gamma(\frac{1}{2})}{t!\,\Gamma(\frac{1}{2}nt - t + 1)} \left[\frac{2c}{\mu g^2 b^n}\right]^t,$$

the series converging only for $b > b_0$, where $\mu g^2 b_0{}^n = \frac{1}{2}n^{n/2}(n-2)$ this being true both for c positive (attractive potentials) and c negative (repulsive potential). This result makes it possible to calculate by analytic integrations, the contributions to the element collision integrals from the range $b > b_0$. It also simplified greatl the calculation integrals for both attractive and repulsive inverse power potentials which can be evaluated entirely by analytic mean for $n > 2$.

53

19194 KINETIC THEORY OF DENSE GASES.

H.B.Hollinger and C.F.Curtiss.

J. chem. Phys., Vol. 33, No. 5, 1386-1402 (Nov., 1960).

The Boltzmann equation is found to be determined to arbitrar order in the density as a consequence of the molecular chaos assumption. A three-body collision approximation is given explicitly and shown to be identical to that implied by the Bogolyubo assumptions; the relation between the molecular chaos assumptio and the Bogolyubov assumptions is discussed. It is shown that the Enskog modification of the Boltzmann equation for dense gases composed of rigid spheres is correct, subject to the molecular chaos assumption. The current disagreement over the correct form for this equation is discussed.

53

19195 MOLECULAR FRICTION IN DILUTE GASES.

J.T.O'Toole and J.S.Dahler.

J. chem. Phys., Vol. 33, No. 5, 1496-1504 (Nov., 1960).

General formulae are derived for the molecular friction coefficients of a dilute gas. The velocity and temperature dependen of these coefficients are examined in detail for several choices of the pair interaction potential. Also considered are the frictional loss of kinetic energy and, for one special case, the dissipation of molecular internal angular momentum. The concepts of free path length and collision frequency are extended to nonrigid molecular models.

53

19196 CONTRIBUTION TO J.DUCLAUX'S THEORY OF A REAL GAS. J.Barriol and A.Weisbecker.

J. Chim. phys., Vol. 57, No. 9, 730-3 (Sept., 1960). In French.

According to Duclaux's treatment, a real gas is treated as a mixture of single molecules, molecule pairs, triplets etc. The la of mass action is assumed to govern the equilibrium between thes various types of aggregate. The authors consider the problem of determining the number of single molecules as a function of the density, and introduce an interpolation process which is claimed lead to a satisfactory solution if the virial coefficients are suppos known. [The notation is thoroughly bad; C, C_1 and C_2 all have mo than one meaning]. H.N.V.Temper

533.7

197 ERRATA: "CONTRIBUTIONS OF BOUND, META-STABLE, AND FREE MOLECULES TO THE SECOND .L COEFFICIENT AND SOME PROPERTIES OF DOUBLE ECULES" AND "INITIAL PRESSURE DEPENDENCE OF MAL CONDUCTIVITY AND VISCOSITY"

togryn and J.O.Hirschfelder.

em. Phys., Vol. 33, No. 3, 942-3 (Sept., 1960).

ee Abstr. 3561, 3567 of 1960. Extensive numerical changes isted and new tables and diagrams presented. P.Gray

533.7

198 STATISTICAL MECHANICAL INTERPRETATION OF WILSON-KISTIAKOWSKY EQUATION.

takeyama and T.Tanaka.

. Fac. Sci. Kyusyu Univ. B, Vol. 3, No. 1, 15-23 (March, 1960).

The method of cluster expansion is used in order to obtain the tion of state of gases at very high temperatures and pressures. result obtained reproduces the experimental data rather well gives a statistical mechanical interpretation of the Wilson-akowsky empirical equation. An empirical formula

$$pV/RT \doteq 1 + x\exp(\beta x),\quad x = (k/V)\{(T-\theta)/T^2\}^{\alpha}$$

h is of somewhat wider applicability is proposed.

533.7

9199 THE SECOND VIRIAL COEFFICIENT OF METHANE AT LOW TEMPERATURE.

homaes and R.Van Steenwinkel.

ire (London), Vol. 187, 229-30 (July 16, 1960).

This was obtained for temperatures in the range 108°-250°K. sample used was estimated to be 99.9% pure, from the range of ting temperature. The results was tabulated, and a favourable parison with the results of Michels and Nederbragt (Abstr. 3 of 1935, 3454 of 1936) is made graphically. P.Gray

533.7 : 536.7

9200 THERMODYNAMIC PROPERTIES FOR P_4.

G.Thyagarajan and F.F.Cleveland.

nolecular Spectrosc., Vol. 5, No. 3, 210-11 (Sept., 1960).

Values of heat content, free energy, entropy, and heat capacity e calculated for the ideal gaseous state at 1 atm pressure, and the rigid-rotor harmonic-oscillator approximation, at 12 tem-atures between 100 and 1000°K

533.7

9201 STUDY OF THE PRESSURE OF SATURATED THALLIUM SELENIDES VAPOURS.

.Shakhtakhtinskii and A.A.Kuliev.

. Metallov i Metallovedenie, Vol. 9, No. 2, 202-4 (Feb., 1960). ussian.

Using the effusion method and radioactive tracer technique, P against 1/T curves are constructed for TlSe, Tl_2Se, and e_3 vapours. The results indicated that volatilization of TlSe and Se takes place without dissociation in the solid phase, whereas e_3 dissociates according to $Tl_2Se_3 \rightleftharpoons Tl_2Se + 2Se$. M.H.Sloboda

533.7 : 536.2

9202 THE VARIATION OF THERMAL CONDUCTIVITY OF GASES AND VAPOURS WITH BOTH TEMPERATURE D PRESSURE. M.El Nadi and E.Salam.

hys. chem. (Leipzig), Vol. 215, No. 1-2, 121-32 (1960).

Sulphur dioxide, carbon dioxide, ethyl chloride, methyl bromide, ylene oxide and dimethylamine were investigated at pressures ween 2.0 and 760 mm Hg and at temperatures between 40° and °C. A comparative procedure was used in which the apparatus calibrated for each thermostat and wire temperature by measur- the conductivity of pure, dry air. Using the absolute value of conductivity of air, the corresponding values were deduced for the ours considered. Values of the calculated thermal conductivity rected to zero pressure are given. The thermal conductivity nged linearly with rise of temperature for all vapours except l chloride and ethylene oxide vapours, which showed a slight rease at higher temperatures. Similarly, Maxwell's law was d not to hold and a linear dependence on pressure was observed.

533.7

19203 SPONTANEOUS VIBRATIONS OF HELIUM GAS IN A 0.3 mm TUBE AT TEMPERATURES BETWEEN 10 AND 20°K. O.V.Lounasmaa.

Ann. Univ. Turku AI, No. 39, 6 pp. (1959).

During the measurements of C_V of helium fluid in the temperature-pressure range 2.5-20°K and 0-100 atm an anomalously large heat flow to the calorimeter was observed between 10 and 20°K. In each case the flow curves showed a pronounced maximum. It is assumed that the large heat leak was due to spontaneous oscillations of helium in the 0.3 mm diameter filling tube leading to the calorimeter. In some cases the heat flow was 10 times larger than that observed for the empty calorimeter in otherwise exactly similar experimental conditions. It was possible to stop these oscillations, which made good C_V-measurements impossible, by changing the length of the filling tube.

533.7 : 537.2

19204 DIELECTRIC CONSTANTS OF IMPERFECT GASES. I. HELIUM, ARGON, NITROGEN, AND METHANE.

D.R.Johnston, G.J.Oudemans and R.H.Cole.

J. chem. Phys., Vol. 33, No. 5, 1310-17 (Nov., 1960).

Measurements from 1 to 100 atm were made at one or more temperatures between −30° and 70°C by a special transformer ratio arm bridge operating at 10 kc/s; derived values of the Clausius—Mossotti function are of sufficient precision (0.1%) to justify comparison with theoretical pair fluctuation, polarizability and multipole moment interaction effects at higher densities. Helium shows a decrease of 0.3% and argon an increase of 0.1% in C-M at 100 atm, while nitrogen and methane show somewhat larger positive effects, especially at lower temperatures. A decreased effective polarizability of atom pairs at small distances is discussed as a possible explanation of the data for helium and argon, while the effect in nitrogen is consistent with quadrupole-induced dipole moments of pairs. A theory of octupole-induced dipole interactions is shown to be capable of explaining the methane results with plausible estimated values of the octupole moment.

533.7

19205 TEMPERATURE DEPENDENCE OF THE VELOCITY OF SOUND IN DENSE GASES. I.Z.Fisher.

Akust. Zh. Vol. 5, No. 4, 459-63 (1959). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No. 4, 470-5 (April-June, 1960).

Gives a sequential-statistical consideration of the effect of inversion of the temperature dependence of the velocity of sound in a gas at high pressure. The one-dimensional and three-dimensional models of a gas are studied.

533.7 : 534.22

19206 MULTIPLE VELOCITY DISPERSION IN HALOMETHANE GAS MIXTURES. J.B.Calvert and R.C.Amme.

J. chem. Phys., Vol. 33, No. 4, 1270-1 (Oct., 1960).

Observed multiple dispersion of sound velocity in halomethane gas mixtures seems to be due primarily to the predominant relaxation mechanisms, which are dependent on the specific heats of the components. Results on $CClF_3$—$CHCl_2F$ and CF_4—$CHClF_2$ mixtures are tabulated. G.I.W.Llewelyn

533.7 : 539.19

19207 NON-ADIABATIC VIBRATIONAL EXCITATION OF MOLECULES IN MOLECULAR COLLISIONS.

E.E.Nikitin.

Optika i Spektrosk., Vol. 9, No. 1, 16-21 (July, 1960). In Russian.

Discusses non-adiabatic vibrational excitation of diatomic radicals in gas-kinetic collisions. It is shown that allowance for non adiabaticity, important when the radicals are in degenerate electronic states, may increase considerably the vibrational excitation cross-section. An estimate of the vibrational de-activation cross-section of NO agrees satisfactorily with the published experimental results, obtained from dispersion of ultrasound or by an optical investigation of shock waves. A.Tybulewicz

533.7

19208 VIBRATIONAL RELAXATION TIMES FOR GAS MIXTURES. L.M.Valley and S.Legvold.

Phys. of Fluids, Vol. 3, No. 5, 831 (Sept.-Oct., 1960).

A relationship is derived for the vibrational relaxation times of gas mixtures exhibiting a single dispersion of sound. Existing experimental data are in good accord with the theoretical relation. W.J.Orville-Thomas

533.7

19209 THERMAL RELAXATION ABSORPTION IN ETHYLENE.

J.C.Gravitt.

J. Acoust. Soc. Amer., Vol. 32, No. 11, 1455-8 (Nov., 1960).

The thermal relaxation absorption in ethylene at temperatures between 0° and 60°C was obtained by the Tube method for frequencies between 150 kc/s and 4 Mc/s per atm. The relaxation time, the transition probability, and the collision efficiency were determined as a function of temperature. The collision efficiency as a function of temperature seems to follow the simple exponential law: $P_{10} \alpha \exp(-c/T^{1/3})$.

533.7

19210 ABSORPTION OF MICROWAVES IN CERTAIN VAPOURS - ETHYL FORMATE, DIETHYL AMINE AND METHYL ACETATE.

G.Krishna Murty.

J. sci. industr. Res., Vol. 18B, No. 11, 455-7 (Nov., 1959).

The absorption coefficient (α) and its variation with pressure (p) were determined for these three molecules. The electric susceptibilities at different pressures were also determined. The α—p curves for ethyl formate and methyl acetate are practically linear except at the end where they tend to reach a saturation value. The curve for diethyl amine is similar to that of ammonia indicating that the resonant frequency in the case of this molecule is far removed from the operating frequency. The absorption in the case of the other two molecules is of the resonant type.

533.7 : 539.2 : 539.14 : 532.7 : 530.16

THEORY OF γ-RAY RESONANCE ABSORPTION IN GASES.

See Abstr. 18992

533.7

19211 ABSORPTION OF ULTRAVIOLET RADIATION BEHIND A SHOCK WAVE IN AIR.

S.A.Losev, N.A.Generalov and L.B.Terebenina.

Optika i Spektrosk., Vol. 8, No. 4, 569-71 (April, 1960). In Russian.

The absorptive power of hot air in the 2250-3400 A region was measured behind the front of a shock wave in a shock tube. The shock-wave velocities varied from 2 to 3.5 km/sec and the gas temperature behind the shock wavefront was 2000-3300°C. The results showed that the absorptive power rises from about 0.05 at 3400 A to about 0.55 at 2300 A. In the 2800-3200 A region absorption maxima were observed. The absorptive power rose with increase of pressure and temperature, particularly at longer wavelengths. The absorption was due to oxygen and nitric oxide.

A.Tybulewicz

533.7

19212 A SPECTROSCOPIC INVESTIGATION OF THE STATE OF GAS BEHIND A SHOCK WAVE. II.

F.S.Faizullov, N.N.Sobolev and E.M.Kudryavtsev.

Optika i Spektrosk., Vol. 8, No. 5, 585-93 (May, 1960). In Russian.

For Pt I see Abstr. 973 of 1960. A generalized spectral line reversal method was used to study the state of air and nitrogen behind 1.8-4.3 km/sec shock waves in a shock tube. Temperatures behind shock wavefronts, obtained using the D-lines of sodium (present as an impurity or deliberately introduced into the shock tube), were in good agreement with theory, and the accuracy of the method was ±60°K at 4000°K. The shock-wave velocity rose with distance away from the shock-tube diaphragm, reaching a maximum some 2.5 m from it. A method of "peaks", which employs refractive index disturabnces on passage of a shock wave, was used to find the length of the region between the shock wavefront and the surface of contact of two gases used in the shock tube (this region is known as the "plug"). The lengths of the "plugs" decreased with rise of the shock-wave velocities. The same method of "peaks" showed that the D-line emission begins immediately behind a shock wave and reaches its maximum after 10-20 μsec. A.Tybulewicz

533.7

19213 A SPECTROSCOPIC INVESTIGATION OF THE STATE OF GAS BEHIND A SHOCK WAVE. III.

F.S.Faizullov, N.N.Sobolev and E.M.Kudryavtsev.

Optika i Spektrosk., Vol. 8, No. 6, 761-8 (June, 1960). In Russian.

For Pt II see preceding abstract. A shock tube, with one or two diaphragms, was employed to produce shock waves of 1.9 to 4.3 km/sec velocities. Temperatures of nitrogen and air in the region between the shock wavefront and the surface of contact of two gases used in the shock tube (this region is known as the "plug") were measured by a generalized version of spectra line reversal (cf. Pt I and II), using the D-lines of Na and the resonance line of Ba II at 4554 A. The measured temperatures decreased along the length of the "plugs" due to a decrease of the shock-wave velocity along the tube. The "plug" temperatures (2000-4500°K) rose with the shock-wave velocity in satisfactory agreement with theory. These experiments were repeated with argon but here the agreement between experiment and theory was much poorer; the reasons for this discrepancy are discussed.

A.Tybulewi

533.7 : 539.

19214 THE OPTICO-ACOUSTIC EFFECT IN MERCURY VAPOUR.

P.I.Bresler and B.N.Ruzin.

Optika i Spektrosk., Vol. 8, No. 5, 733-5 (May, 1960). In Russian.

Monatomic mercury vapour was irradiated with light from a mercury lamp producing the 2537 A wavelength. Measurements showed that the optico-acoustic effect in mercury vapour mixed wi air or argon fell rapidly from the moment when ultraviolet irradiation (2537 A) began and practically disappeared in 4-5 min, due to oxidation of mercury vapour by atmospheric oxygen or its traces present in argon. When mercury vapour was mixed with hydrogen the optico-acoustic effect first rose in magnitude (for 6-8 min), then remained constant for 12-14 min and finally started to fall. This was due to a photochemical reaction which led to the dissociation of hydrogen molecules; alternatively, the behaviour of the mercury—hydrogen mixture can be explained by exothermal reacti between hydrogen and traces of oxygen in it, sensitized by mercury vapour. A.Tybulewic

533.7 : 541.

19215 THE OPTICO-ACOUSTIC EFFECT IN THE VISIBLE AND ULTRAVIOLET REGIONS, AND ITS RELATIONSHIP WITH PHOTOCHEMICAL REACTIONS IN GASES.

P.I.Bresler and B.N.Ruzin.

Optika i Spektrosk., Vol. 9, No. 1, 22-5 (July, 1960). In Russian.

Reports the optico-acoustic effect for nitrogen dioxide in the visible region and for chlorine in the near ultraviolet region (the latter effect is strongly enhanced by addition of hydrogen, due to a photochemical reaction between chlorine and hydrogen). Gives the "gas characteristics" of a prototype optico-acoustic gas analyser for chlorine. A.Tybulewic

533.7 : 53

19216 THEORY OF THE COMPLEX REFRACTIVE INDEX.

C.A.Mead.

Phys. Rev., Vol. 120, No. 3, 854-9 (Nov. 1, 1960).

For previous work, see Abstr. 3847 of 1958, 3153 of 1959. A quantum-mechanical formalism is developed for representing the complex refractive index of a gas, including both dispersive and absorptive parts. In analogy with some previous work by the author it is shown that the phenomenological Maxwell equations are obeyed as equations between certain matrix elements of operators representing the field quantities. The method makes us of a canonical transformation due to Arnous and Bleuler, and also of the "damping operators" previously introduced by the author. It is shown that the calculation of the complex refractive index reduces to the calculation of a single diagonal matrix element of a damping operator. The actual evaluation of this matrix element is taken up in the following paper.

533.7 : 53

19217 RESONANCE BROADENING OF SPECTRAL LINES.

C.A.Mead.

Phys. Rev., Vol. 120, No. 3, 860-6 (Nov. 1, 1960).

See also preceding abstract. A formalism introduced previousl by the author is used to calculate the shape of an absorption line in gas, taking account of the "resonance" interaction between like ato The most serious approximation is the neglect of the effect of translational motion. An asymmetric line is obtained, with the maximum shifted slightly toward the red. Some simple classical consideratio also agree qualitatively with the results. Various properties of the line shape obtained are briefly discussed. The neglect of translational motion makes it impossible to compare the results with experiments performed up to the present time.

533.7 : 535.33

19218 STUDY OF THE SCATTERING SPECTRUM OF NICKEL CARBONYL VAPOUR.

M.Bigorgne and A.Chelkowski.

C.R. Acad. Sci. (Paris), Vol. 251, No. 4, 538-40 (July 25, 1960). In French.

ın experimental arrangement for photographing the Raman
rum is described. Measured frequencies and the corresponding
nments are listed. Certain frequencies are less than corres-
ng values for the liquid. See also Abstr. 19156

G.F.Lothian

533.7 : 535.33 : 536.46

219 ABSORPTION SPECTRA OF LOW-PRESSURE FLAMES.

A.G.Gaydon, G.N.Spokes and J.van Suchtelen.

. Roy. Soc. A, Vol. 256, 323-33 (July 5, 1960).

Absorption spectra of low-pressure flames, which have a
ively thick reaction zone, were studied by means of a multiple-
ction system to increase the effective path length in the flame
. To obtain a background source of sufficient brightness
erature to reverse the absorption bands, a flash tube and rotat-
ector device were employed. For a rather rich oxyacetylene
, the (0,0) Swan band of C_2 and the 3143 A band of CH were
rved in absorption for the first time in steady flames. A value
ne reversal temperature of C_2 was obtained. Rich-limit low-
sure flames of ethers and aldehydes show formaldehyde absorp-
In rich flames of dimethyl ether, acetaldehyde, acetone and
ane, a band of the CH_3 radical at 2157 A was observed, and in
es of diethyl ether, and of ethane, a new band with maxima at
and 2242 A was provisionally assigned to the C_2H_5 radical.
absorption by OH and OD radicals in flames of mixed $C_2D_2 + H_2$
examined. Results are discussed.

533.7 : 535.33

9220 THE ABSORPTION OF LIGHT BY CALCIUM VAPOUR (2100 TO 1080 A).

R.W.Ditchburn and R.D.Hudson.

c. Roy. Soc. A, Vol. 256, 53-61 (May 31, 1960).

Continuous absorption and line absorption of radiation in
cium vapour was measured from the $4s4s\,^1S_0 \rightarrow 4snp\,^1P_1$ series
it at 2028 to 1080 A. Two perturbed series of auto-ionization
s ($4s4s\,^1S_0 \rightarrow 3dnp\,^1P_1$) are recorded and analysed. A second
ies limit is observed at 1589 A. This is probably two unresolved
its corresponding to the two series of auto-ionization lines. No
orption lines are observed on the short-wavelength side of 1589 A.
f-values of the lines vary from 2.4×10^{-2} to 6×10^{-5} and the
-lives (calculated from measurements of the half-widths of the
s) vary from 30 to 260×10^{15} s. The f-value for the
$s\,^1S_0 \rightarrow 4snp\,^1P_1$ continuum is estimated to be 0.012 (including an
wance for a portion below 1589 A) and the f-value for the
tinua from wavelength 1589 to 1080 A corresponding to the two
ies of auto-ionization lines is estimated to be 0.003. The
asured value of the absorption near 2028 A is about one-fiftieth
he theoretical value which has been used in astrophysical
culations.

533.7 : 535.37

19221 AN IMPROVED TECHNIQUE FOR THE OBSERVATION OF INFRARED CHEMILUMINESCENCE: RESOLVED RARED EMISSION OF OH ARISING FROM THE SYSTEM $H + O_2$.

.Charters and J.C.Polanyi.

ad. J. Chem., Vol. 38, No. 10, 1742-55 (Oct., 1960).

A multiple reflection apparatus for the observation of infrared
miluminescence is described. By means of this apparatus, infra-
emission from the system $H + O_2$ has been identified as being
to vibrationally excited OH radicals in levels $\nu = 1, 2,$ and 3 of
ground electronic state. The resolved infrared spectrum of the
fundamental has been observed for the first time without inter-
ence from other emission. The most likely source of excited OH
ne reaction $H + HO_2 \rightarrow OH^* + OH$. The vibrational "temperature"
H* (vibrationally excited OH in its ground electronic state) in
present system is in the region of $T_V = 2240^\circ K$. These findings
discussed in relation to Krassovsky's suggestion that reaction
veen H and O_2 could account for the Meinel hydroxyl bands in the
t sky.

VACUUM PHYSICS

533.5

19222 STANDARD UNIT OF PRESSURE IN VACUUM PHYSICS.

N.A.Florescu.

ure (London), Vol. 188, 303 (Oct. 22, 1960).

A proposal is made for a new unit of pressure in vacuum
sics directly related to the absolute pressure [it turns out that
s unit would merely give another name to the well-known millibar
(mb) defined as 10^3 dyn/cm^2 in B.S. 350: Part 1: 1959]. The new unit would be equivalent to $\frac{3}{4}$ torr to within less than one part in 10^4.

W.Steckelmacher

533.5

19223 ULTRA HIGH VACUUM TECHNOLOGY.

G.L.Munday.

Nuclear Instrum. and Methods, Vol. 4, No. 5, 367-75 (June, 1959).

The production of ultra high vacuum ($\cong 10^{-9}$ torr) as a means of eliminating unwanted impurities is considered with reference to thermonuclear devices. The literature and some opinions are briefly reviewed on the methods of measuring and production of these low pressures. Material characteristics are considered in relation to the special requirements of all metal systems which can be baked at 400-450°C. Methods of fabrication of chambers with demountable joints, windows and shut-off valves that can withstand repeated brake-out are reviewed.

533.5 : 537.533 : 621.385.1

19224 INTERNATIONAL SYMPOSIUM ON RESIDUAL GAS IN ELECTRON TUBES AND IN SIMILAR HIGH-VACUUM SYSTEMS.

Nuovo Cimento Suppl., Vol. 12, No. 3, 297-329 (1959).

In French, German, Italian and English.

This symposium was held in Como in September 1959. Summaries only are given of the 47 papers that were presented. These summaries nevertheless contain a useful amount of practical information.

533.5

19225 NONPROPORTIONALITY IN THE BAYARD—ALPERT IONIZATION GAUGE.

F.A.Baker.

Rev. sci. Instrum., Vol. 31, No. 3, 911 (Aug., 1960).

Measurements were made with a special Bayard—Alpert gauge with two grids between filament and ion-collector. The grid adjacent to the filament allows the current to the second grid to be altered without altering the filament temperature. The positive ion current was directly proportional to the electron current indicating that previous explanations of the deviation from linearity observed with the more normal gauge may be incorrect.

R.D.Smith

533.5

19226 ERRONEOUS READINGS OF LARGE MAGNITUDE IN BAYARD—ALPERT IONIZATION GAUGE AND THEIR PROBABLE CAUSE.

G.Barnes.

Rev. sci. Instrum., Vol. 31, No. 10, 1121-7 (Oct., 1960).

Experimental work is described in which pressure fluctuations as great as two order of magnitude as recorded by a new type of cold-cathode vacuum gauge were undetected by a Bayard—Alpert ionization gauge. It is shown that the Bayard—Alpert gauge measures the pressure inside its electron-accelerating grid only and not that within the remainder of the evacuated system. Operation of the heated filament of this gauge within a glass tube or near glass parts gives rise to sodium, potassium, and other low ionization-potential materials throughout the vacuum system but in spite of being a major source of contamination, the Bayard—Alpert gauge does not detect the presence of these substances. This is because such low ionization-potential materials are photoionized by the light from the heated filament and cannon penetrate the positively charged electron-accelerating grid in order to be detected. Some other effects related to the phenomenon are discussed.

533.5

19227 USE OF McLEOD GAUGES AT ROOM TEMPERATURE FOR GASES WITH HIGH CRITICAL TEMPERATURES.

H.J.Bixler, A.S.Michaels and R.B.Parker.

Rev. sci. Instrum., Vol. 31, No. 10, 1155 (Oct., 1960).

533.5

19228 A THERMIONIC CATHODE IONIZATION GAUGE TUBE FOR PRESSURE MEASUREMENT UP TO 10^{-1} TORR.

G.Hinzpeter.

Exper. Tech. der Phys., Vol. 8, No. 2, 89-95 (1960). In German.

Operating conditions for thermionic ionization gauges at higher pressures than usual are discussed. A gauge having a rectangular-box electrode system with a central cathode was investigated. Two opposite sides formed the electron collectors (at + 100 V), the other two sides the ion collector (at −5 V), and with an electron current of 50 μA calibration characteristics up to several torr were obtained. The pressure—ion-current curves (at constant electron current) were linear up to 1.5 × 10^{-1} torr for nitrogen, 3 × 10^{-2} torr for argon and 5 × 10^{-1} torr for neon. Calibration data for ordinary triode ionization gauges under similar operating conditions were also obtained. W.Steckelmacher

533.5

19229 A THERMAL CONDUCTIVITY GAUGE FOR ACCURATE HIGH VACUUM MEASUREMENTS. I.I.Sherif.

Proc. Math.Phys. Soc. Egypt, No. 22, 53-8 (June, 1958).

A modified compensated thermal conductivity gauge is described in which all factors affecting the heat transfer through gases are considered. The gauge covers a wide range of measurements. Calibration curves are nearly straight lines at both medium and very low pressures.

533.5

19230 A THREE-ELECTRODE FORM OF COLD CATHODE IONISATION GAUGE.

G.K.T.Conn, H.N.Daglish and A.Hogg.

Vacuum, Vol. 7-8, 72-9 (1957-58: publ. April, 1959).

The introduction of a third electrode in a cold cathode gauge leads to a number of practical advantages. The characteristic change of mode found with the conventional gauge may be eliminated; since the mode change leads to a discontinuity in the graph of ion current against pressure, this is a real merit. The sensitivity of the gauge may be changed and improved over a range of pressures which may be selected by adjustment of the voltage. In particular, the instrument may be used as a vacuum switch. In the cases which have been examined, the relative dimensions of the electrodes are important.

533.5

19231 ON A THERMISTOR-PIRANI GAUGE OF HIGH SENSITIVITY. A.A.Arafa, F.S.A.Sultan and I.S.Shafie.

Z. angew. Math. Phys., Vol. 7, No. 1, 75-80 (Jan. 25, 1956).

Gives the operating characteristics of a Pirani gauge in which the bridge arm adjacent to the gauge head consists of a semiconducting element with a negative temperature coefficient of resistance. The gauge has a higher sensitivity (5.88 × 10^{-6} mm Hg/μA) and is linear over a wider range than the ordinary Pirani gauge.

J.Dutton

533.5 : 537.56

DISCHARGE MECHANISM OF PHILIPS IONIZATION GAUGE.

See Abstr. 19614

533.5

19232 CALIBRATION SYSTEMS IN VACUUM TECHNIQUE.

J.Pierre.

Vide, Vol. 15, 210-19 (May-June, 1960). In French and English.

The calibration of vacuum gauges is considered under dynamic conditions in which the pressure is set by pumping against a set leak. At low pressures molecular beaming from the leak can cause unequal pressure conditions in vacuum gauges connected to such a system. Hence a symmetrical arrangement of gauges relative to pump and leak is suggested or the leak is positioned below a baffle system above the pump mouth. The use of pressure-measuring gauge probes to investigate pumps is also discussed.

W.Steckelmacher

533.5

19233 FLUID TRAPS IN VACUUM TECHNIQUE.

J.Pierre.

Vide, Vol. 15, 313-23 (July-Aug., 1960). In French and English.

Various baffle systems designed to intercept and prevent the migration of pumping fluid from the vapour pump into the vacuum system are considered. The efficiency and conductance of baffles based on conical, helicoidal and rectangular baffle surfaces worked out and an optimum angle of tilt of 35° obtained in all these designs. In the optimum case the pumping speed reduction due to the baffle was found to be of the order of 30%. W.Steckelmacher

533.5

19234 AN ALL METAL LEAK VALVE

P.Bouyer, C.Cassignol and P.Lazeyras.

Vide, Vol. 15, 297-300 (July-Aug., 1960). In French and English.

The construction of a metal-bellows-sealed control valve is described in which a non-rotating hard steel pin is driven into a brass seating. A differential screw drive was used to obtain fine flow control down to about 6.5 × 10^{-6} torr-l./sec [with atmospher pressure differential].

W.Steckelmach

533.5 : 535

19235 FLAP-VALVE FOR LONG NARROW APERTURES.

G.W.King.

J. sci. Instrum., Vol. 37, No. 11, 439-40 (Nov., 1960).

The photographic plate chamber of a vacuum spectrograph wa isolated by an O-ring sealed plate valve the construction of which described.

W.Steckelmach

533

19236 HIGH VACUUM GAS-LEAK VALVES.

L.Paty.

Vacuum, Vol. 7-8, 80-6 (1957-58: publ. April, 1959).

This paper gives a brief survey of a variety of types of valves suitable for the controlled admission of gases into a high vacuum system. The principal features of this type of valve are discussed first and followed by a more detailed description of the following: Needle valves, slit valves, valve fitted with porous plu valves operating by means of rubber plugs pressed into grooves machined into the housing, valves admitting an intermittent flow of gas, and valves, the action of which depends on the effect of tempe ature variations in the construction materials.

533.5 : 537.53

19237 LENS MASS-SPECTROMETER LEAK DETECTOR.

D.Cossutta and W.Steckelmacher.

J. sci. Instrum., Vol. 37, No. 11, 404-10 (Nov., 1960).

A new mass-spectrometer leak detector was investigated base on the use of an iron-shrouded axially symmetrical magnetic lens for focusing ions in the low mass range. By taking precautions to keep the hydrogen background at a low and stable level (by the use of a mercury-vapour pump, liquid-air traps and clean construction it was possible to use hydrogen as a search gas. Leaks of 5 × 10^{-10} torr litre per sec corresponding to an indication of a change in ion current reading of about 3 × 10^{-13} A (for hydrogen) were consistently detected with an almost instantaneous response when testing equipment of a few litres volume using either hydroge or helium as search gas. Some measurements of the mass spectru obtained with this instrument are given. A very reliable and convenient version of a compressed-powder leak is also described.

533.

19238 A VACUUM DESICCATOR.

H.R.Munden.

Vacuum, Vol. 7-8, 87-8 (1957-58: publ. April, 1959).

The apparatus described was specially designed for the drying of photographic plates prior to subjecting them to high vacuum conditions.

533.5 : 539.2

19239 DIRECT OBSERVATION OF SURFACE CONTAMINATIO FORMED IN DEMOUNTABLE VACUUM SYSTEMS.

D.E.Bradley.

Nature (London), Vol. 187, 227-8 (July 16, 1960).

Adsorbed layers of contamination were observed by viewing them end-on in an electron microscope. Vertical steps were create with evaporated carbon films and exposed to the contaminating atmosphere of a pumping plant. A second carbon film was then evaporated at an angle against the step. In the electron microscope a thin line indicated the contaminating layer between the two carbon films. In 1 sec a layer estimated to be 10 A thick was formed and dynamic equilibrium was reached in 20 min. The technique was als applied to the measurement of evaporated film thickness.

W.Steckelmache

533.5

19240 A NEW EVAPORATION SOURCE FOR VACUUM DEPOSITION OF ALUMINIUM.

S.Tabata, M.Iwata and T.Sawaki.

Vacuum, Vol. 7-8, 88-90 (1957-58: publ. April, 1959).

533.

19241 NEW HIGH-VACUUM TECHNIQUE: KITS TO BE USED BY STUDENTS TO MAKE VACUUM TUBES.

J.H.O.Harries.

Amer. J. Phys., Vol. 28, No. 8, 698-704 (Nov., 1960).

In order to teach modern microphysics successfully it has been necessary for the students to make their own vacuum tubes. aking vacuum tubes by standard techniques involves an expen- e on equipment of many thousands of dollars and the services hly skilled technicians. A research programme been carried hich resulted in a technique whereby students can make their acuum tubes by using a Meccano-like kit of parts at a cost of tens of dollars per kit. No skilled technicians are necessary igh vacua (10^{-7} to 10^{-8} mm Hg) are obtained without the custo- precautions as to cleanliness and without costly equipment. methods of exhaust are used: (1) A method using activated oal, CO_2 a special gettering regime, and a vacuum gauge. method using a mechanical pump with the same gettering ne and vacuum gauge. A students' kit has been designed and ited. Some classroom experiments have been demonstrated. acuum technique and kits have applications in research and try as well as in teaching.

VIBRATIONS · ACOUSTICS

534.1 : 538.56

9242 **BEATING OF WEAKLY-COUPLED NONLINEAR SYSTEMS.** W.Braunbek and E.Sauter.

hys., Vol. 160, No. 3, 233-46 (1960). In German.

Expressions for the slowly varying amplitudes and phase-differ- of two undamped nonlinear mechanical or electrical systems weak coupling are developed and discussed. The method em- ed is the Krylov–Bogolyubov approximation, according to which ifferential equations of the second order for the oscillating tities are replaced by differential equations of the first order he amplitudes and the phase-difference. The results are in e cases compared with the results of a Runge-Kutta numerical ration by electronic digital computer.

534.1 : 621.289

9243 **FORCED OSCILLATION OF A SPRING–MASS SYSTEM HAVING COMBINED COULOMB AND VISCOUS DAM- G.** E.S.Levitan.

coust. Soc. Amer., Vol. 32, No. 10, 1265-9 (Oct., 1960).

An analytic solution for the response of the support-excited em is presented. The solution to the equation of motion is loped through the application of a Fourier Series to represent frictional force opposing the relative motion between mass and orting structure. It is assumed that no stops occur during any ion of the steady-state oscillation. The results are presented form convenient for observing the influence of system meters.

534.11

9244 **ON THE VERIFICATION OF THE EXTENDED KAR FORMULA FOR MINIMUM BOWING PRESSURE.**

tta.

n J. theor. Phys., Vol. 5, No. 4, 105-10 (Dec., 1957).

The extended Kar formula for minimum bowing pressure is fied by the data obtained by the writer in a previous experiment. tr. 2731 of 1956).

534.12

9245 **MOMENT IMPEDANCE OF PLATES.**
I.Dyer.

coust. Soc. Amer., Vol. 32, No. 10, 1290-7 (Oct., 1960).

The moment impedance of an infinitely extended plate is cal- ted with the use of plate equations that allow for transverse r deformation and rotatory inertia. It is shown that the effects ansverse shear deformation may be important even for thin s, a result that is not contained in classical theory. Classical ry is shown to be inadequate when the distance over which the ent is applied is smaller than plate thickness. The moment edance for geometries of greatest practical interest is found to ist of a resistance connected in series with a stiffness react- , both roughly inversely proportional to frequency, with the re- nce of greater magnitude. Both the resistance and the reactance ease with decreasing distance over which the moment is applied, use of the increasing importance of transverse shear flexibility. practical implications of the results are discussed, and some ghts are given concerning other problems where classical ry for flexural waves in thin plates may not be applicable.

534.12

19246 **MECHANICAL IMPEDANCES FOR THIN PLATES.**
D.A.Thomas.

J. Acoust. Soc. Amer., Vol. 32, No. 10 1302-4 (Oct., 1960).

Boundary conditions are applied to the solution of the thin-plate wave equation using Mindlin's consideration of the effects of rotary inertia and transverse shear flexibility to obtain an improved expression for outgoing flexure waves in an infinite, thin plate. This solution is used to obtain improved expressions for the distributed mechanical impedances and the driving point impedance of the plate. For very thin plates these expressions reduce to those previously published (Abstr. 8638 of 1958).

534.12

19247 **FORCED VIBRATION OF A CLAMPED RECTANGULAR PLATE IN FLUID MEDIA.** G.C.K.Yeh and J.Martinek.

Akust Beihefte [Acustica], No. 1, 104-8 (1956).

Forced vibration of a thin rectangular plate clamped in a rigid infinite baffle is analysed. The plate is assumed to separate two different fluid media and the vibration is excited by a simple plane wave of high frequency (as compared with $c/2\sqrt{\pi ab}$) normally incident from one side of the plate. Using the characteristic shape functions the Lagrange equations of motion of the plate are set up in generalized coordinates. The solutions of the equations render series expressions for the plate deflection and an energy transmission coefficient. Certain numerical results are given.

534.13

19248 **MEASUREMENTS OF MECHANICAL IMPEDANCES BY A RESONANCE METHOD.**

A.Gigli and G.G.Sacerdote.

Akust.Beihefte [Acustica], No. 1, 180-5 (1956).

The behaviour is studied of a system composed by two bars vibrating longitudinally, matched by a mechanical quadrupole, and ended by two mechanical impedances. After the general relations, some particular problems are examined; the influence of the supports, the behaviour of a partially coated bar and the measurement of the mechanical impedance of thin layers of deadening materials.

534.13

19249 **GUIDE RODS FOR THE MEASUREMENT OF FLEXURAL WAVES.** S.Vogel.

Akust. Beih. [Acustica], No. 2, 511-20 (1956). In German.

Mechanical impedances may be measured in a way analogous to measurements in the acoustical impedance tube and the electrical transmission line. A metal rod is used to transmit flexural waves, and mechanical impedances are measured as a function of the length and the termination of the rod. The various terminations are obtained by using an electrodynamical system attached to the rod, and capable of exerting forces as well as couples. This enables a reflection-free termination to be obtained in three ways, by using either a pure couple or a pure transverse force or both simultaneously with suitable amplitude and phase. Apart from the electromechanical damping, a study is made of the non-reflecting termination obtained with wedge-shaped terminations using layers of sand as damping material. Their absorption is measured as a function of frequency for various lengths, profiles and sand loads. The amplitude distribution along the length of the wedges enables conclusions to be drawn about the damping mechanism.

534.13

19250 **NOTE ON FORCED TORSIONAL VIBRATION OF A VISCO-ELASTIC CIRCULAR CYLINDER.** S.K.Datta.

Bull. Calcutta Math. Soc., Vol. 51, No. 4, 167-70 (Dec., 1959).

534.13

19251 **VIBRATIONS OF THICK-WALLED HOLLOW CYLINDERS: EXACT NUMERICAL SOLUTIONS.**

J.F.Bird, R.W.Hart and F.T.McClure.

J. Acoust. Soc Amer., Vol. 32, No. 11, 1404-12 (Nov., 1960).

The plane-strain vibration frequencies of an infinitely long hollow cylinder are calculated exactly with the aid of a high-speed electronic computer for a range of wall thicknesses and azimuthal node numbers and for a variety of boundary conditions. These latter cover the cases: outer radial surface free, supported or clamped; inner surface free, supported, or matched to a gas filling the inner cavity. In the last case, the attenuation of sound in the cylinder wall is calculated, in addition to the eigenfrequencies. The computations of mode frequencies disclose that: (i) the shear-compressional wave coupling in the solid is very weak (except for low frequency); (ii) for the gas-filled cylinder, the modes are very close either to the gas quasimodes (gas in a rigid-walled cylinder), or to the solid quasi-modes (shell with free inner surface), depending on the geometry.

534.13

19252 VIBRATIONS OF THICK-WALLED HOLLOW CYLINDERS: APPROXIMATE THEORY. J.F.Bird.
J. Acoust. Soc. Amer., Vol. 32, No. 11, 1413 19 (Nov., 1960).

This paper presents an approximate theory (with sample calculations) for the thickness eigenmodes of an infinitely long hollow cylinder of arbitrary wall thickness, and subject to a variety of boundary conditions. Beginning with the earlier observation that the coupling between shear and compression waves in the solid wall is weak, a perturbation theory is deduced by which approximate eigenfunctions can easily be computed by hand, with accuracy better than several percent provided the number of radial nodes is more than a few. The perturbation method can also be used to compute the attenuation of sound in the cylinder wall.

534.13

19253 VIBRATION PATTERNS OF LOADED BARIUM TITANATE AND QUARTZ DISKS.
E.A.G.Shaw and R.J.Sujir.
J. Acoust. Soc. Amer., Vol. 32, No. 11, 1463-92 (Nov., 1960).

In previous work (Abstr. 2734 of 1956), the normal surface displacement patterns of thick barium titanate disks vibrating in various normal modes were obtained using multiple-beam optical interference. This technique has now been used to determine the effect of loading a disk with a liquid in contact with one plane surface. It is found that the discrete modes observed with an unloaded disk begin to merge so that the vibration patterns show a continuous transition with changing frequency as one passes from one mode to the next in the "thickness resonance" region. The radiation damping of the individual modes is appreciably less than the theoretical value, but the bandwidth covered by the group is appreciably greater than is to be expected from the simple theory of thickness resonance. In the case of a quartz disk, two modes with a frequency separation of 0.5% merge fairly completely when the disk is loaded, and the vibration patterns indicate composite motion of a more uniform character than that of either mode alone.

534.13

19254 VIBRATION OF QUARTZ CRYSTAL PLATES.
R.P.Jerrard.
Quart. appl. Math., Vol. 18, No. 2, 173-81 (July, 1960).

An analysis is made of convex quartz plates, with anisotropic elastic constants, vibrating predominantly in the thickness shear mode with slight flexural vibration. Assuming the displacement small at the edges compared with that at the centre frequencies have been computed for various ratios (r), of edge to centre thickness, and various length crystals. For small values of r the fundamental thickness shear mode frequency approaches that of an infinite flat plate of uniform thickness. A.P.C.Thiele

534.13

19255 INVESTIGATION OF THE SPECTRA AND FORMS OF VIBRATION OF THE SURFACE OF PIEZO-PLATES.
B.A.Finagin.
Zh. tekh. Fiz., Vol. 30, No. 9, 1115-23 (Sept., 1960). In Russian.

Bending, longitudinal and thickness vibrations of tourmaline and quartz plates over a wide frequency range were analysed by an optical interference method, and photographs of the vibrating plates are reproduced, together with data on the frequencies. For some practical purposes longitudinal or bending vibrations may be more suitable than thickness vibrations. R.F.S.Hearmon

534.2

19256 PLATE WAVES AND FLEXURAL OSCILLATIONS OF A PLATE. Yu.K.Konenkov.
Akust. Zh., Vol. 6, No. 1, 57-64 (1960). In Russian. English translation in: Soviet Physics-Acoustics (New York), Vol. 6, No. 1, 52-9 (July-Sept., 1960).

The paper examines the propagation of flexural waves along a plate in the form of an infinite elastic strip. The cases that arise when the edge of the strip is free, clamped, and hinged are considered. The corresponding dispersion equations are found and solved, and the properties of the first-order plate waves are studied.

534.

19257 CONDUCTANCE OF A GROUP OF HOLES.
V.S.Nesterov.
Akust. Zh., Vol. 5, No. 4, 440-4 (1959). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No.4 451-5 (April-June, 1960).

The Fok equation for the conductance of holes is applied to single holes in acoustic lines, and to several holes combined in a group. The results of an experimental tests demonstrating the suitability of the adopted equation for calculation of the acoustic properties of a group of holes are cited.

534

19258 THE PROPAGATION OF ELASTIC SURFACE DEFORMATIONS IN A SHOCK EXCITED SOLID BODY.
H.Hänsel and H.Schardin.
Akust. Beihefte [Acustica], No. 1, 168-73 (1956). In German.

The propagation of elastic deformations in solids excited by shocks have been studied by means of high speed cinematography. For some specimens of steel and glass excited by an explosive charge or a projectile the pictures show the propagation of two deformation fronts and their reflections at the edges. The propagation velocities of these fronts are in accordance with the velocities of longitudinal and transversal waves respectively in a medium of infinite extension. Finally, the influence of shock fronts on the enlargement of surface cracks has been studied.

534.

19260 EXPERIMENTAL DETERMINATION OF STRESSES GENERATED BY AN ELECTRIC DETONATOR.
J.S.Rinehart and W.C.McClain.
J. appl. Phys., Vol. 31, No. 10, 1809-13 (Oct., 1960).

The magnitude, duration and spatial distribution within a solid body (Plexiglas) of the transient stress disturbance generated by a electric detonator detonated in intimate contact with the body has been experimentally determined. The technique is to affix to one surface of the body a small pellet of the same material, which flies off when the disturbance reaches the surface, the velocity of the pellet being determined. The complete stress-time curves are bui up by using pellets of several thicknesses. Three types of detonator have been used with these being placed flat ended agains the surface of a Plexiglas block. A few were confined. The stress the Plexiglas was found to be distributed more or less uniformly about the axis of the detonator. Along the axis both peak pressure and total momentum decreased with distance from the detonator: peak pressure exerted by an Olin Mathieson No. 6 Plasti-cap range from 9500 lb/in^2 at 1.25 in. from the detonator to 7000 lb/in^2 at 2.0 in.; and the momentum ranged from 16×10^{-3} $lb\text{-}sec/in.^2$ at 1.25 in. to 9.0×10^{-3} $lb\text{-}sec/in.^2$ at 2.0 in. The disturbance lasted about 2 μsec. Similar results were obtained with the other detonators.

534.2

19259 ON COMPRESSIONAL WAVES IN THE DIRECTION OF THE AXIS OF A CYLINDRICAL HOLE IN AN ANISOTROPIC MEDIUM HAVING HEXAGONAL SYMMETRY.
S.K.Chakraborty.
Bull. Calcutta Math. Soc., Vol. 51, No. 4, 142-4 (Dec., 1959).

534.2

19261 DISTURBANCES IN AN ELASTIC MEDIUM BY IMPULSIVE FORCES IN A CYLINDRICAL HOLE.
S.K.Chakraborty.
J. Assoc. Appl. Physicists, Vol. 4, No. 4, 143-51 (Dec., 1957).

The propagation of disturbance in an isotropic elastic medium containing a cylindrical hole has been considered in cases of motion produced by some impulsive forces acting on the surface of the cylindrical hole.

534.2 : 550.3

19262 PROPAGATION OF ELASTIC WAVE MOTION FROM AN IMPULSIVE SOURCE ALONG A FLUID/SOLID INTERFACE. I. EXPERIMENTAL PRESSURE RESPONSE. W.L.Roever and T.F.Vining.
II. THEORETICAL PRESSURE RESPONSE. E.Strick.
III. THE PSEUDO-RAYLEIGH WAVE. E.Strick.
Phil. Trans A, Vol. 251, 455-65, 465-88, 488-523 (Sept. 15, 1959).

Pt I and II compare the experimentally observed pressure response for the impulse-excited fluid/solid interface problem with

derived from a corresponding theoretical investigation. In the
riment a pressure wave is generated in the system by a spark
detected with a small barium titanate probe. The output of the
e is displayed on an oscilloscope and photographed. Two cases
investigated: one where the transverse wave velocity is lower
the longitudinal wave velocity of the fluid and the other where
ransverse wave velocity is higher. Both of these observed
onses are shown to agree even as to details of wave-form, with
t computations made for a delta-excited line source. This com-
son is justified by making an approximate calculation for the
ying point source and showing that at these distances it does not
r appreciably from the delta-excited line source. In the case of
transverse wave velocity one finds, besides critically refracted
irect, and reflected waves, a Stoneley type of interface wave.
ough the emphasis in recent years has been towards minimizing
importance of Stoneley waves, the evidence here is that a Stoneley
e can be the largest contributor to a response curve. In the case
igh transverse wave velocity the critically refracted P wave is
ller, and the Stoneley wave, though it tends to maintain a rather
stant amplitude, becomes compressed in time and arrives very
after the reflection. Between the critically refracted P wave
the direct arrivals one finds both experimentally and theoretic-
a pressure build-up preceding the arrival time that might be
ected for a critically refracted transverse wave.

In Pt III this pressure build-up is investigated and found to con-
of the superposition of three arrivals. The most prominent of
e is a pseudo-Rayleigh wave. The others are the critically
acted transverse wave and the build-up to the later arriving
eley wave. Detailed investigation of the pseudo-Rayleigh wave
ws it to have the velocity of a true Rayleigh wave which is in-
endent of the existence of the fluid. Furthermore, it has the same
ograde particle motion as the true Rayleigh wave. However, it
adiating into the fluid as it progresses and therefore has many
e properties of a critically refracted arrival when measure-
ts are made in the fluid. Mathematically it differs from the
Rayleigh wave in that its origin is not from a pole on the real
of the plane of the variable of integration, but rather from a
which lies on a lower Riemann sheet in the complex plane. In
high transverse wave velocity case this pole is not too far re-
ed from the real axis and the imaginary part of the pole location
ht be interpreted as a decay factor. The real part, however,
ds only approximately the velocity of the pseudo-Rayleigh wave,
the actual velocity as pointed out above is precisely that of the
Rayleigh wave velocity. The migration of this complex pole
lains why such a pseudo-Rayleigh wave was not observed in Pt I
II in the low transverse velocity case. The problem under dis-
sion is intimately related to the classic work of Lamb (1904).
need make only a minor re-interpretation of the source function
rder to compare directly the wave-forms (excluding of course
Stoneley wave contribution). A method is suggested for obtain-
the solid rigidity of bottom sediments in water-covered areas
n in situ measurements of the pseudo-Rayleigh wave and/or
eley wave velocities and arrival times.

534.2

19263 A LINE SOURCE ON AN INTERFACE BETWEEN A FLUID AND AN ELASTIC SOLID. V.M.Papadopoulos.

oc. Roy. Soc. A, Vol. 257, 515-33 (Sept. 27, 1960).

In this paper the problem of interaction between infinitesimal
turbances propagated in a fluid and in an elastic solid across an
nite plane interface is examined by the method of dynamic simi-
ity. The disturbance is the result of the setting up, at time $t = 0$,
n infinite line source of constant strength on the interface; the
d source means a line singularity within the fluid associated with
ux which is uniform in all directions and with zero circulation.
n from the solid, the singularity is a line of pressure which is not,
ever, uniform in all directions. There are three propagation
ocities involved, the velocity of sound in the fluid and the veloci-
of shear and dilatation waves in the solid. The form of the
turbance depends on the relative magnitudes of these velocities,
well as on the relative densities of the two media. Within the
itations of the theory of propagation of weak shocks, the method
ynamic similarity, which is closely related to the conical flow
hod of Busemann leads to exact formulae for the stress and
ocity components everywhere; these results satisfy the correct
tinuity conditions at the interface. The non-uniform way in which
solution approaches the corresponding elastic half-space solu-
when the density of the fluid is small relative to that of the solid is described, and the non-uniform way in which the surface wave velocity is affected by the relative density is also discussed. Specific results which are found are that a pair of lines of stagnation move away from the source in opposite directions on the interface with the exact velocity of the Rayleigh wave for the solid. There is another pair of stagnation lines moving with velocity $2^{1/2}c_2$, where c_2 is the velocity of shear waves, but only in cases when this velocity is smaller than the sound velocity in the fluid.

534.21

19264 SECOND APPROXIMATION IN THE METHOD OF SMOOTH PERTURBATIONS. T.A.Shirokova.

Akust. Zh., Vol. 5, No. 4, 485-9 (1959). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No. 4, 498-503 (April-June, 1960).

Deals with propagation of plane waves in media with large-scale random variations of the refractive index. A second approximation is found in the method of smooth perturbations (the Rytov method) on the assumption that the correlation coefficient of fluctuations in the refractive index is Gaussian in form. The form of the normalizing multiplier in the wave equation is determined. The limits of applicability of the Rytov method are discussed.

534.21 : 538.56

19265 LIMITS OF APPLICABILITY OF THE METHOD OF "SMOOTH" PERTURBATIONS IN THE PROBLEM OF RADIATION PROPAGATION THROUGH A MEDIUM CONTAINING INHOMOGENEITIES. V.V.Pisareva.

Akust. Zh., Vol. 6, No. 1, 87-91 (1960). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 6, No. 1, 81-6 (July-Sept., 1960).

Considers the problem of finding the limits of applicability of the method of "smooth" perturbations in solving the problem of the propagation of radiation through a medium containing inhomogeneities. In this connection, the results obtained in the papers of Obukhov, Chernov, and Scheffler for the mean-square values of the phase and amplitude fluctuations and amplitude-correlation function are discussed. The conditions are determined under which the effect of a layer with inhomogeneities on the transmitted radiation can be replaced by the perturbing action of an equivalent phase screen.

534.21 : 538.56

19266 PROPAGATION OF ACOUSTIC AND ELECTROMAGNETIC WAVES IN A HALF-SPACE. M.D.Khaskind.

Akust. Zh., Vol. 5, No. 4, 464-71 (1959). In Russian. English translation in: Soviet—Acoustics (New York), Vol. 5, No. 4, 476-84 (April-June, 1960).

The propagation of acoustic and electromagnetic waves in a half-space is considered, where the impedance at the boundary of the half-space is given in the form of an arbitrary complex number. The solution is based on the introduction of a functional combination that reverts to zero at the boundary of the half-space. Expressions for the acoustic and electromagnetic potential are found in terms of this functional combination in different cases, taking into account the asymptotes, which depend on the specific values of the impedance.

534.21

29267 CERTAIN EFFECTS IN THE PROPAGATION OF SOUND IN THE SEA. A.L.Sosedova.

Akust. Zh., Vol. 5, No. 4, 445-9 (1959). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No.4, 456-60 (April-June, 1960).

The propagation of sound in the sea was investigated experimentally, given certain forms of the sound velocity distribution in depth. The results were compared with theoretical curves showing the dependence of the sound intensity on distance. Two experimental observations were made: a secondary-ray emergence towards the surface and the focusing of sound at short ranges.

534.21

19268 INVESTIGATION OF THE PROPAGATION OF LOW-FREQUENCY SOUND IN SHALLOW WATER. V.S.Grigor'ev and F.I.Kryazhev.

Akust. Zh., Vol. 6, No. 1, 34-42 (1960). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 6, No. 1, 30-7 (July-Sept., 1960).

A procedure is described for the experimental investigation of the propagation of sound at low frequencies in shallow water. Experimental data are cited, characterizing certain features of the waveguide propagation of sound under the conditions of a shallow-water reservoir and a shallow sea.

534.21 : 539.3

LONGITUDINAL WAVE PROPAGATION IN STRETCHED POLYMERS. See Abstr. 18251

534.21

19269 A METHOD FOR CALCULATING THE AMPLIFICATION FACTOR OF CONVERGING BEAMS OF SOUND.
B D Tar[illegible]
Akust. Zh. Vol. 5, No. 4, 450-8 (1959). **In Russian.** English translat[illegible] Physics—Acoustics (New York), Vol. 5, No.4, 461-9 (Apr[illegible]).

An ap[illegible] method is described for calculating the dependence of the amplification factor of focusing systems on the focusing action of a nonuniformity in the distribution of the amplitude over the wave-front in conjunction with phase aberration. Graphs are shown for calculated normalized functions representing a generalization of the Fresnel integrals for the calculation of systems, as well as graphs illustrating the role of a nonuniformity in amplitude and of phase aberration of various forms.

534.21

19270 EXPERIMENTAL INVESTIGATIONS INTO THE WAVEGUIDE PROPAGATION OF SOUND IN LAMINAR-INHOMOGENEOUS MEDIA.
A.N.Barkhatov and I.I.Shmelev.
Akust. Zh., Vol. 5, No. 4, 403-7 (1959). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No.4, 414-18 (April-June, 1960).

A procedure for the laboratory simulation of a waveguide in laminar-inhomogeneous media is presented. The results of an experimental investigation of the sound field in media in which the axis of the waveguide lies both on the surface of the inhomogeneous fluid and below it are cited. The fields in the region of the first geometric shadow and in the region of the first caustic are studied in detail. In the latter case a comparison is made between the experimental data and theory.

534.21 : 538.56

19271 FIELD STRUCTURE IN CYLINDRICAL WAVEGUIDES WITH A COMPLEX CROSS-SECTION. V.V.Merkulov.
Akust. Zh., Vol. 5, No. 4, 428-32 (1959). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No. 4, 439-43 (April-June, 1960).

Using the method of conformal transformations, the solution of the wave equation in a two-dimensional region with complex boundaries is reduced to the problem of solving a wave equation with variable coefficients in a region with simple boundaries. The integration of the equation so obtained is performed with the aid of perturbation theory, where the ratio of the distance between the corresponding points of the boundaries of the complex and simple regions to the "scale of inhomogeneity" of the boundaries of the complex region is a small parameter. As an example the field of a wave E_{11} in a rectangular waveguide with a concave upper wall is calculated.

534.21

19272 ON THE ACOUSTIC RECTIFIER.
L.X.Nepomuceno.
Acustica, Vol. 8, No. 5, 342-3 (1958). In German.

Reference is made to a previous paper by Falkenthal (Abstr. 1756 of 1931) in which sound rectifying properties were ascribed to various grating systems. The "rectifier" used by the author to convert alternating pressures in a sound wave to unidirectional pressure, makes use of a bank (or a series of banks) of thin-walled half-cylinders, the sound vibrations passing more readily in one direction than in the opposite direction. A.B.Wood

534.22

19273 VELOCITY OF SOUND IN WATER AS A FUNCTION OF TEMPERATURE AND PRESSURE.
A.M.Srivastava and Y.P.Varshni.
Indian J. Phys., Vol. 33, No. 10, 423-30 (Oct., 1959).

It is shown that the variation of velocity of sound (u) in water with temperature (t) at different pressures can be represented by $u = a + bt + ct^2$. Using Smith and Lawson's data (Abstr. 4281 of 1954), maximum velocity temperatures at different pressures have been calculated. T maximum velocity temperatures appear to increase with the incre in pressure but at very high pressures the data are inconclusive.

534.

19274 MEASUREMENT OF THE VELOCITY OF SOUND IN WATER AS A FUNCTION OF THE TEMPERATURE U TO 300° C AND PRESSURE UP TO 150 kg/cm². S.Elberg.
C.R. Acad. Sci. (Paris), Vol. 251, No. 5, 654-6 (Aug. 1, 1960). In French.

The velocity is measured in terms of the time interval betwee successive echoes formed by reflection of an ultrasonic pulse at th end of a tube. Control of the water temperature is better than ±0.2% and pressure ±1%. An estimated uncertainty of 1 part in 2 is introduced into the time measurement and velocity due to the co tinually decreasing sharpness of the leading edge of each successi echo. This order of relative precession is confirmed by comparis with more accurate values of the room temperature velocity. At higher temperatures and pressures the measured variation of the velocity, $C_{p,t}$, is found to fit the law

$$C_{p,t} = A_0 + A_1t + A_2t^2 + A_3t^3 + A_4t^4$$

to better than 1 part in 1000. A table of numerical values for the c efficients is given. The measured temperature dependences of the velocity and also of the adiabatic compressibility of water are sho graphically. See also Abstr. 2896 of 1958; 10708 of 1959.
J.D.Rand

534.2

19275 DETERMINATION OF THE VELOCITY OF SOUND IN DISTILLED WATER. R.Brooks.
J. Acoust. Soc. Amer., Vol. 32, No. 11, 1422-5 (Nov., 1960).

The velocity of sound is determined in distilled water over the temperature range from 22° to 25°C. The method used consists of measuring the transit time of two sound paths of different length travelling between the crystal faces of two barium-titanate transducers. With an accurate measure of the length, the velocity is determined from the quotient of $\Delta l/\Delta t$. It is believed that the accuracy of the measurements is within ±1 ft/sec.

534.2

19276 EQUATION FOR THE SPEED OF SOUND IN SEA WATER. W.D.Wilson.
J. Acoust. Soc. Amer., Vol. 32, No. 10, 1357 (Oct., 1960).

An equation is given for the speed of sound in sea water. The experimental data used to determine this equation were obtained in the temperature, pressure, and salinity ranges $-4°C < T < 30°C$; $1\ kg/cm^2 < P < 1000\ kg/cm^2$, and $0‰ < S < 37‰$. The standard deviation of the experimental data was found to be 0.30 m/sec.

534.2

19277 RELATIVISTIC THEORY OF SHOCK WAVES.
W.Israel.
Proc. Roy. Soc. A, Vol. 259, 129-43 (Nov. 22, 1960).

The paper is concerned with the relativistic theory of shock phenomena in a simple, nonconducting fluid. Three conditions on the equation of state are exhibited which yield the result (demanded by the principle of causality) that the shock speed shall always be less than the fundamental velocity c. By a consideration of one-dimensional continuous flow, an additional condition, expressing the stability of compressive shocks, is derived. On the basis of the four conditions, it is then proved that, as in the classical theory, entropy rises across a compressive shock, and the transition in the fluid velocity relative to a normally incident shock is from supersonic to subsonic.

534.2

19278 A METHOD OF CALCULATION OF [THE PROPAGATI OF] SHOCK WAVES. V.F.Kuropatenko.
Dokl. Akad. Nauk SSSR, Vol. 133, No. 4, 771-2 (Aug. 1, 1960). In Russian.

A set of simultaneous difference equations is substituted for corresponding differential equations of aerodynamics. Procedures for solving the equations are described. R.Eisenschi

534.

19279 INTENSE STRESS FIELD PRODUCED IN A SEMI-INFINITE ELASTIC SOLID BY A BOMB BLAST AT T SURFACE. H.Serbin.

ɔust. Soc. Amer., Vol. 32, No. 10, 1250-6 (Oct., 1960).
'he response of a solid subjected to intense blast pressures
ds on the ratio of the applied pressures to the stresses (yield
s, etc.) characteristic of the material of the solid. When this
is small, the solid can be expected to respond elastically.
lastic theory of a semi-infinite solid exposed to a blast ini-
at a point on the surface, assumed to be in air at sea level
reloped. The results are explicit expressions for the displa-
nts and stresses for early time, small radial distances, and
ow depths. Application to the case where the solid represents
ırth is discussed.

534.22

9280 PROPAGATION OF INTENSE SHOCK WAVES INTO THE EARTH. H.Serbin.

oust. Soc. Amer., Vol. 32, No. 10, 1257-62 (Oct., 1960).
See preceding abstract. The behaviour of a semi-infinite solid
ing elastically to a point-initiated blast wave at the surface has
considered. When applied pressures are sufficiently high, the
will experience inelastic behaviour characteristic of the
rial. The earth is here regarded as a medium made up of
matter, water, and air voids. It is assumed that the principal
t of high normal stresses is to close up the air voids and that
after the medium acts like an elastic solid. The calculation
peak pressure versus depth is compared with experimental
derived from nuclear bomb tests and shows reasonable agree-
considering the wide scatter of test points.

534.22 : 523.877

SHOCK WAVES IN STELLAR ENVELOPES. See Abstr. 18856

534.23

9281 THEORY OF SOUND RADIATION BY THIN ELASTIC SHELLS AND PLATES. L.M.Lyamshev.

st. Zh., Vol. 5, No. 4, 420-7 (1959). In Russian. English
slation in: Soviet Physics—Acoustics (New York), Vol. 5, No. 4,
-8 (April-June, 1960).
The radiation of sound by elastic isotropic shells vibrating
er the action of forces that are regular or statistically distri-
d over the surface of the shell is studied theoretically. An
gral relation, connecting the radiation field with the diffraction
d of the shell when the latter is free of mechanical forces, is
ived. The spectral intensity of the statistical field in the case
ound radiation by cylindrical and spherical shells, as well as a
plate vibrating under the action of statistically distributed
ces, are calculated.

534.23

19282 NONSTATIONARY RADIATION OF SOUND BY A PISTON. A.A.Kaspar'yants.

st. Zh., Vol. 6, No. 1, 52-6 (1960). In Russian. English
nslation in: Soviet Physics—Acoustics (New York), Vol. 6, No. 1,
51 (July-Sept., 1960).
The nonstationary field of short-wavelength sound waves formed
plane piston radiator, the action of which is begun in a gas
ially at rest, is studied. In the process of building up the statio-
y regime a motion having the nature of a pulse, the form of which
losely connected with the form of the radiator, is observed, and
intensity depends on the phase of the radiator action at the
ant it is begun.

534.23

19283 THE PROBLEM OF RADIATION FROM BENDING WAVES. L.Cremer and G.Schwantke.

st. Beith. [Acustica], No. 1, 329-35 (1957). In German.
To take into account the effect that the receiving enclosure has
the radiation of vibrating plates, an improved model is used in
ch the radiation into a rectangular enclosure open at one side is
sidered. The radiation is characterised by the normalised mean
are value of the sound pressure, for planes parallel to the plate.
sideration of the near field leads to a distance dependence for
quencies below the cut-off frequency. The response shows two
ima, one on either side of the cut-off frequency f_g. As the
nber of half wave-lengths that fit on to the plate increases, the
ncipal maxima approach each other and the response tends
mptotically towards that obtained with an infinite plate. Poles
to enclosure resonances are avoided by introducing a finite wall
edance. It is not possible to give a strict expression for the
iation using the quotient f/f_g only. Rather, as an additional para-
ter the mode of vibration of the plate is of major importance.
From this it follows, however, that one and the same plate may show a variety of radiation characteristics, depending on the width of the plate and on the enclosure of which it forms a bounding surface.

534.23

19284 SOUND FIELD OF A FIRST-ORDER PLATE WAVE IN A LAYER OF WATER. F.I.Kryazhev.

Akust. Zh., Vol. 6, No. 1, 65-76 (1960). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 6, No. 1, 60-70 (July-Sept., 1960).

Considers the field of a first-order plate wave in a plane-parallel water layer lying over a bottom having no shear elasticity. Reports the results of a study of the properties of a first-order plate wave with the propagation of sound in shallow water under actual conditions and a determination of the properties of the bottom on the basis of the plate-wave characteristics. Gives a comparison of the theoretical and experimental data.

534.23

19285 SOUND FIELD IN THE FOCAL PLANE OF SPHERICALLY CONVERGING BEAMS. B.D.Tartakovskii.

Akust. Zh., Vol. 6, No. 1, 96-100 (1960). In Russian. English translation in: Soviet Physics — Acoustics(New York), Vol. 6, No. 1, 92-6 (July-Sept., 1960).

The amplitude distribution of the acoustic-particle velocity and acoustic pressure in the focal plane of beams of spherical sound waves with a finite flare angle is considered, where the beams are characterized by a nonuniform amplitude distribution over the wave-front. Here it is assumed that a sizable variation in amplitude over the wave-front, of the same order of magnitude as the amplitude itself, occurs at distances greater than λ/π. Just as in the analysis of the amplification factor, the amplitude distribution function over the front is expressed by a polynomial, the integration of which permits the solution to be presented in the form of special functions.

534.23

19286 A SOUND SOURCE FOR THE PRODUCTION OF SHORT DURATION PULSES. W.Burgtorf.

Akust. Beih. [Acustica], No. 1, 325-8 (1957). In German.

An apparatus that produces short and reproducible sound pulses by purely mechanical means is described. It acts as a point source of high energy.

534.23 : 536.2

ACOUSTIC OSCILLATIONS DURING PERIODIC EVOLUTION OF HEAT. See Abstr. 19477

534.23

19287 SOUND ABSORPTION AND SOUND DISPERSION IN GASEOUS NITROGEN AND OXYGEN AT HIGH FREQUENCY/PRESSURE VALUES. G.Sessler.

Acustica, Vol. 8, No. 6, 395-7 (1958). In German.

Measurements have been made of sound absorption and dispersion in nitrogen and oxygen at 20° C and frequency/pressure (f/p) values of 10^6 to 10^9 cycles/atm. The method used is the interferometric arrangement described in an earlier paper (Abstr. 2899 of 1958). Reference is also made to papers by Greenspan [Abstr. 3203 of 1954; 6441 of 1956; and J. Acoust. Soc. Amer., Vol. 30, 672 (1958)]. Experimental values of the ratios of absorption, α, to dispersion, β, (α/β) are plotted as a function of the ratio f/p. In the case of nitrogen the ratio α/β falls from 0.3 to 0.01 as the ratio (f/p) decreases from 10^9 to 10^7. For oxygen the experimental curve is much the same as for nitrogen. The experimental results are in good agreement with theory. A.B.Wood

534.23

19288 BUBBLE TRANSDUCER FOR RADIATING HIGH-POWER LOW-FREQUENCY SOUND IN WATER. C.C.Sims.

J. Acoust. Soc. Amer., Vol. 32, No. 10 1305-8 (Oct., 1960).

The bubble transducer consists of a conventional low-impedance electrodynamic driver with an air-filled rubber membrane, or "bubble," of adjustable volume over the diaphragm. The system at resonance produces large volume displacement of the water with small linear diaphragm displacement at frequencies below 200 c/s. For constant diaphragm volume velocity, the addition of the resonating bubble increases the power output by a factor of approximately 1000.

534.23

19289 RADIATION RESISTANCE OF MAGNETOSTRICTIVE-STACK TRANSDUCER IN PRESENCE OF SECOND TRANSDUCER AT AIR—WATER SURFACE.

F.B.Stumpf and F.J.Lukman.

J. Acoust. Soc. Amer., Vol. 32, No. 11, 1420-22 (Nov., 1960).

The radiation resistance of a nickel magnetostrictive-stack transducer in the presence of an identical in-phase transducer at an air—water surface was obtained. The transducers are resonant at 20 kc/s and their radiating surfaces are squares whose sides are 0.38 of the wavelength in water. Curves were obtained for the radiation resistance versus separation distance for electrical driving forces of the interacting transducer which were 1.0, 2.0, and 3.0 times the electrical driving force of the reference transducer. It was found that for a given driving force ratio, the radiation resistance with interaction oscillated about the value for the radiation resistance of the transducer with no interaction and that these oscillations decreased in amplitude as the separation distance was increased. Near 2λ, the interaction effect became negligible. Furthermore, it was found that the interaction increased with increasing electrical driving force of the interacting transducer. Qualitative agreement is found with treatments of the interaction radiation resistance of other physical situations, but an adequate analytical study of this case is needed.

534.23

19290 MATERIALS OF EXTREMELY HIGH INTERNAL DAMPING.

H.Oberst.

Akust. Beihefte [Acustica], No. 1, 144-53 (1956). In German.

These materials are useful for diminishing the propagation of disturbing noise by solid structures. They may be used as building materials, as damping layers on metallic structures, as spring elements for vibration isolation or structure-borne sound insulation, etc. Extremely high internal losses can be obtained with high polymers (rubber and plastics), if use is made of the elastic dispersion which is due to molecular relaxation processes occuring in the visco-elastic range of the materials. The dispersion ranges in which the absorption has a maximum value can be systematically shifted to the desired frequencies and temperatures if the mixtures of which the materials consist are suitably chosen. Damping materials which are in technical use as adhesive layers on metal sheet structures have been adjusted in this way. The vibration damping of the metal sheets which is obtained with sufficiently thick layers is comparable to the inner damping of soft cork, and it can be shown that it will scarcely be possible to attain an essentially higher damping efficiency.

534.23

19291 EXPERIMENTAL INVESTIGATIONS INTO THE SOUND INSULATION OF CYLINDERS.

M.Heckl.

Akust. Beih. [Acustica], No. 1, 259-65 (1958). In German.

There are two characteristic frequencies related to the sound insulation of hollow cylinders. One of them is the radial-resonance frequency. For frequencies higher than the radial-resonance frequency, the sound insulation of a hollow cylinder corresponds to that of a plane plate. The second characteristic frequency is given when the wavelength in air is equal to the diameter of the tube. For lower frequencies the sound insulation depends very much on the directivity of the exciting sound source and the length of the cylinder. Between these two frequencies, well marked transmission bands are observed when exciting with noise of small band-width. When exciting with noise of octave band-width, the insulation is found to be nearly independent of frequency. The sound insulation is different depending on the position of the sound source inside or outside the tube.

534.23

19292 THE OSCILLATION OF AIR PARTICLES IN MODELS OF POROUS SOUND ABSORBERS.

H.W.Helberg.

Acustica, Vol. 9, No. 3, 155-63 (1959). In German.

For a given Rayleigh type of model the input impedance is calculated exactly, with allowance for viscosity and thermal conduction, and the damping and phase velocity in front of the model is estimated for the case of grazing incidence. A large model on the Rayleigh principle, a cross-grating model and a statistical model, all made of small Rayleigh elements were made. These were placed in turn as absorbers on the walls of a tube of square section. Small suspended particles make the sound field visible in and in front of the absorber. Measurements of propagation between 16 and 2500 c/s in the model and in the tube agree with the theo
The circulation of air in the absorbers was also observed.

534.23 : 541

19293 THE ABSORPTION OF ULTRASOUND IN ELECTROLYTES.

M.I.Shliomis.

Akust. Zh., Vol. 6, No. 1, 116-19(1960). In Russian. English translation in: Soviet Physics — Acoustics (New York), Vol. 6, No. 1, 112-15 (July-Sept., 1960).

Two mechanisms for the absorption of sound in electrolytes
considered. One of these is connected with the electroacoustic e
The other is caused by the relative motion of the ions and solven
that arises with the propagation of sound in the solution. An equa
tion is obtained for the absorption coefficient and a numerical determination of the effects discussed is given.

534.23 : 541

19294 THERMAL ATTENUATION OF SOUND IN A HIGHLY CONCENTRATED SUSPENSION.

N.L.Bȳzova and V.S.Nesterov.

Akust. Zh., Vol. 5, No. 4, 408-14 (1959). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No
419-25 (April-June, 1960).

The problem of thermal losses in a highly concentrated susp
sion is solved by means of a model consisting of solid spheres, s
rounded by spherical fluid shells. Equations for the complex cor
pressibility, velocity, and attenuation of sound are obtained as a
function of frequency and geometric and thermodynamic paramet
of the suspension. The limits of applicability of the theory publis
earlier, which did not take into account the interaction between th
particles, are clarified. The role of heat losses is quite small in
the cases of a suspension of mineral particles in water and is ve
significant in the case of dry quartz sand saturated with air.

534.23 : 53

ULTRASONIC ATTENUATION IN THE CRITICAL REGION.

See Abstr. 19135

534

19295 EFFECT OF BOUNDARIES ON WAVES IN A THERMC
ELASTIC SOLID: REFLEXION OF PLANE WAVES FROM A PLANE BOUNDARY.

H.Deresiewicz.

J. Mech. Phys. Solids, Vol. 8, No. 3, 164-72 (Aug., 1960).

Investigated are some of the phenomena resulting from the incidence of plane thermoelastic waves on a plane, traction-free, thermally radiating boundary.

534.26 : 538

19296 DIFFRACTION OF A SCALAR WAVE BY A SLIT AND BY A CIRCULAR APERTURE IN A SCREEN OF ARBITRARY THICKNESS.

M.V.Butrov.

Akust. Zh., Vol. 6, No. 1, 16-22 (1960). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 6, No.
13-19 (July-Sept., 1960).

Following the established method of Levine and Schwinger, a
stationary expression is obtained for the coefficients of transmiss
through a slit and circular aperture in a plane screen of arbitrary
thickness. Graphs are given, showing the dependence of the transmission coefficient on the thickness of the screen and diameter of
the aperture for the one case of a comparison function for the fiel
in the plane of the aperture.

534.26 : 535

19297 ON DISSIMILARITY IN THE PHENOMENA OF DIFFRACTION OF SOUND AND LIGHT BY TRANSMISSION GRATINGS.

G.M.Sreekantath.

Acustica, Vol. 8, No. 5, 341-2 (1958).

It is suggested that because of the respective longitudinal anc
transverse modes of vibration the formula for the intensity of sou
diffracted by a slit should have a factor $\cos^2\theta$ not contained in tha
for light, θ being the angle of diffraction. Attempts at experimen
confirmation are so far not conclusive. W.T.Welf

534

19298 EMPIRICAL STUDY OF THE EFFECT OF DIFFRACT
ON VELOCITY OF PROPAGATION OF HIGH-FREQUENCY ULTRASONIC WAVES.

H.J.McSkimin.

J. Acoust. Soc. Amer., Vol. 32, No. 11, 1401-4 (Nov., 1960).

The effect of diffraction in increasing the velocity of propaga

he plane wave value is determined experimentally by phase
arison of reflected longitudinal waves in fused silica blocks. It
wn that the parameters of transducer diameter, path length
lled, and frequency can usually be adjusted to keep the fractional
s velocity under 0.02% for measurements in the 20-100 Mc/s
. This consideration is of particular importance in connection
recision measurement of elastic moduli.

534.26

9299 DIFFRACTION OF A PLANE SOUND WAVE BY AN INFINITE CYLINDRICAL CAVITY IN AN ELASTIC
IUM WITH AN ARBITRARY ANGLE OF INCIDENCE.
Tyutekin.
t. Zh., Vol. 6, No. 1, 101-6 (1960). In Russian. English
slation in: Soviet Physics — Acoustics (New York), Vol. 6,
., 97-102 (July-Sept., 1960).

The diffraction of a plane sound wave by a infinite cylindrical
y with an arbitrary angle of wave incidence with respect to the
of the cavity is considered. Solutions are obtained for the
ar and vector potentials in the form of a superposition of
drical waves of different orders. The dependence of the ampli-
of the zero wave on the angle of incidence and the frequency
nsidered in detail.

534.26

19300 INVESTIGATION OF EXACT SOLUTIONS OF NON-STATIONARY DIFFRACTION PROBLEMS IN THE
GHBOURHOOD OF SLIDING FRONTS.
Buldȳrev and I.A.Molotkov.
. Akad. Nauk SSSR, Vol. 134, No: 5, 1051-4 (Oct. 11, 1960).
ussian.

The diffraction is studied in a two-component acoustical
ium with a cylindrical or a spherical boundary, due to a point
ce (in time and in space). If Q is the source point and P is the
rver's point then the sliding front is the path along which
mat's least time principle is satisfied. The field intensity is
ulated in the vicinity of such front in terms of asymptotic
ansions of appropriate integrals. In particular, first coefficients
symptotic expansion are calculated for cylindrical boundaries.

J.K.Skwirzynski

534.26 : 538.56

19301 DIFFRACTION OF A PULSE BY A RESISTIVE HALF-PLANE. I. NORMAL INCIDENCE. V.M.Papadopoulos.
c. Roy. Soc. A, Vol. 255, 538-49 (May 10, 1960).

The two-dimensional wave diffraction problem, acoustic or
ctromagnetic, in which a pulse of step-function time dependence
diffracted by a resistive half-plane is solved by assuming dy-
nic similarity in the solution. See also following abstract.

534.26 : 538.56

19302 DIFFRACTION OF A PULSE BY A RESISTIVE HALF-PLANE. II. OBLIQUE INCIDENCE.
M.Papadopoulos.
c. Roy. Soc. A, Vol. 255, 550-7 (May 10, 1960).

The three-dimensional problem which arises when a plane
se is incident obliquely at the edge of a resistive half-plane
discussed, and the relations between this case and that of nor-
l incidence (described in Pt I, see preceding abstract) are given.

534.26

19303 ON THE SCATTERING OF [SOUND] WAVES BY A DISK. A.E.Heins and R.C.MacCamy.
angew. Math. Phys., Vol. 11, No. 4, 249-64 (July 25, 1960).

The solution for an arbitrary wave is expressed as a series of
utions of Fredholm integral equations. These can be solved for
all wave-number with boundary conditions corresponding to both
npletely absorbing and completely reflecting disks. No numerical
ults.

W.T.Welford

534.26 : 538.56 : 621.371

BACKSCATTERING FROM A FINITE CONE. See Abstr. 17106

534.26

19304 SCATTERING OF SOUND WAVES BY THE UNEVEN SURFACE OF AN ELASTIC BODY. D.S.Grasyuk.
st. Zh., Vol. 6, No. 1, 30-3 (1960). In Russian. English
nslation in: Soviet Physics—Acoustics (New York), Vol. 6, No. 1,
9 (July-Sept., 1960).

The problem of the scattering of sound by an uneven boundary between a fluid and solid object is solved. The unevenness is assumed to be periodic with an amplitude small in comparison with the wavelength of the incident radiation. Applying the approximate method of Rayleigh, the amplitudes of the waves sliding along the surface and of the shear waves in the solid object are determined. It is shown that, with small angles of incidence (below 12°) the shear waves can be neglected.

534.26

19305 THE PROBLEM OF SURFACE RESONANCE ON A SINUSOIDAL SURFACE. Yu.P.Lȳsanov.
Akust. Zh., Vol. 6, No. 1, 77-80 (1960). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 6, No. 1, 71-4 (July-Sept., 1960).

Based on a modified method of Rayleigh, the effect of surface resonance on an inclined sinusoidal surface with a small amplitude is investigated.

534.39

19306 EXPERIMENTAL STUDY OF ACOUSTIC STREAMING IN WATER. E.V.Romanenko.
Akust. Zh., Vol. 6, No. 1, 92-5(1960). In Russian. English translation in: Soviet Physics — Acoustics (New York), Vol. 6, No. 1, 87-91 (July-Sept., 1960).

An experimental investigation is made on the dependence of the velocity of acoustic streaming in water, due to waves of finite amplitude, on the pressure amplitude and waveform. The dependence resembles a square law when the waveform is sinusoidal or saw-tooth. With the transition of a sinusoidal waveform to a sawtooth, an anomaly is observed in the increase in acoustic-streaming velocity with increasing wave amplitude.

534.39

19307 SONICALLY-INDUCED MICROSTREAMING NEAR A PLANE BOUNDARY. I. THE SONIC GENERATOR AND ASSOCIATED ACOUSTIC FIELD. F.J.Jackson and W.L.Nyborg.
J. Acoust. Soc. Amer., Vol. 32, No. 10, 1243-50 (Oct., 1960).

An experimental arrangement is described which permits controllable generation of small-scale acoustic streaming, i.e., "microstreaming" near a plane boundary S. This arrangement, which consists essentially of a cylindrical bar oscillating longitudinally above the boundary S in question, has been used in studies of sonically-produced effects at a fluid—solid interface. First order pressure and velocity fields in the thin layer of fluid between S and the vibrating face of the bar are discussed. Theoretical expressions are developed, based on a simple model in which incompressible flow is assumed. Experimental determination of the pressure field was accomplished by means of a special hydrophone arrangement described herein, which measures the pressure at points along the plane boundary. The first order theory agrees well with experiment, and is thus judged satisfactory as basis for a detailed treatment of the microstreaming flow. A byproduct of the work is a method for calibration of small hydrophones.

534.39

19308 SONICALLY INDUCED MICROSTREAMING NEAR A PLANE BOUNDARY. II. ACOUSTIC STREAMING FIELD.
F.J.Jackson.
J. Acoust. Soc. Amer., Vol. 32, No. 11, 1387-95 (Nov., 1960).

Results of a comprehensive study of the microstreaming flow field associated with the aforementioned experimental system (preceding abstr.) are discussed in some detail. Photographs are shown of the various flow configurations, and data are presented on streaming speeds as a function of significant experimental parameters. Theoretical expressions are developed along lines of conventional acoustic streaming theory to describe various features of the flow. The correlation between theory and experimental results is found to be good when certain criteria, described herein, are fulfilled.

534.4

19309 A METHOD FOR DETERMINING THE WIDTH OF THE FRONT OF AN ACOUSTIC WAVE SIMILAR IN FORM TO A SAWTOOTH. L.K.Zarembo.
Akust Zh., Vol. 6, No. 1, 43-6 (1960). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 6, No. 1, 38-41 (July-Sept., 1960).

A method is proposed for the determination of the front width a periodic sawtooth wave from a measurement of the spectral mponent waves. The width of the front can be estimated approxitely from the absorption. From the standpoint of the method prosed the existing data in the literature on the spectral analysis of vtooth waves in water are discussed.

534.6

19310 INSTRUMENTS FOR PLOTTING REFRACTED RAYS. O.P.Galkin and V.S.Grigor'ev.

ust. Zh., Vol. 6, No. 1, 23-9 (1960). In Russian. English nslation in: Soviet Physics—Acoustics (New York), Vol. 6, No. 1, 5 (July-Sept., 1960).

The paper examines the fundamental design principles of omatic continuous-operation instruments capable of plotting an regate of sound rays in a laminar-inhomogeneous medium on basis of a given law for the velocity-of-sound distribution (or ocity-of-sound gradient) over the vertical coordinate.

534.6

19311 MEASUREMENT OF TOTAL ACOUSTIC POWER OF SOURCES OF SOUND IN A REVERBERATION CHAMBER.

.Mørch.

a polytech. Scand., Ph. 8, (No. 286/1960). 25 pp.

The report summarizes the theory of the reverberant sound d, and an account of the reverberation chamber investigations at laboratory is given. The reverberation chamber is to be used measurement of the total acoustic power of sources of sound. estigations were carried out at frequencies between 2 and 15 kc/s.

534.6

19312 ON THE NEW REVERBERATION CHAMBER WITH NONPARALLEL WALLS (STUDIES ON THE MEASURENT OF ABSORPTION COEFFICIENT BY THE REVERBERATION AMBER METHOD. II). K.Sato and M.Koyasu.

Phys. Soc. Japan, Vol. 14, No. 5, 670-7 (May, 1959).

For previous work,see Abstr. 13128 of 1959. The details of new reverberation chamber are given. It has a volume of m^3 and is surrounded by nonparallel walls. The results of del room experiments previously reported have been used to ermine the shape and volume of this chamber. At 500 c/s, the erberation time of empty chamber was 22 sec. The position of microphone and the sound absorbing material did not affect the erberation time of this chamber. This fact would show that the nd field of this chamber would fulfil the requisite for the diffuse nd field which is the premise of the reverberation chamber thod.

534.6

19313 MEASUREMENTS OF THE VELOCITY DISTRIBUTION ON PLATES AND MEMBRANES. K.Fehér.

ust. Beihefte [Acustica], No. 1, 99-103 (1956). In German.

The velocity distribution on plates and membranes has been ermined by the help of its known relation to the directional pattern ong distances. The practicability of the method is demonstrated some examples.

534.6

19314 THE MEASUREMENT OF IMPACT SOUND INSULATING MATERIALS IN THE LABORATORY. W.Furrer.

ust. Beihefte [Acustica], No. 1, 160-3 (1956). In German.

The elastic constants of materials used for insulating impact nd can be determined by an oscillation test. An apparatus able for such measurements is described. With the exception riction, which is of secondary importance only, the constants also be ascertained statically; this method is simple and rapid entirely sufficient for all practical purposes. Some typical asured results are shown.

534.6

19315 MEASUREMENT UNDER LOAD OF STRUCTURE-BORNE SOUND DAMPING BY ISOLATING MATERIALS.

Eisenberg.

ust. Beihefte [Acustica], No. 1, 186-8 (1956). In German.

Improvement of the method of Exner and Böhme (Abstr. 2207 1954) for isolation measurements under load. Examination of a ries of materials commonly used in building practice and for chine mountings under pressures up to about 10 kg/cm^2. In st materials the isolation decreases greatly with rising load.

5

19316 STRUCTURAL VIBRATION MEASURING INSTRUME AND METHODS. K.Tamm.

Akust Beihefte [Acustica], No. 1, 189-95 (1956). In German.

A general survey of the methods of representing the vibrator state of solids by means of the spatial and temporal distributions the velocity and acceleration and their properties (absolute sensi tivity, frequency response, directional selectivity, constancy with respect to time), as well as methods for the absolute calibration, are dealt with in detail. Excitation systems are described which permit determination of the vibration behaviour under well define states of excitation, also some combined systems which can be used as impedance meters.

53

19317 A SIMPLE STRUCTURE-BORNE SOUND MEASURING INSTRUMENT FOR ARCHITECTURAL ACOUSTIC APPLICATIONS. K.Gösele.

Akust. Beihefte [Acustica], No. 1, 205-6 (1956). In German.

The apparatus described in this article consists of a condens microphone attached to a pressure chamber which is closed by a piston excited by the vibrating wall. By means of this device the amplitude of vibration can be determined with a relatively high sensitivity.

534

19318 AN ELECTRODYNAMIC STRUCTURAL VIBRATION DETECTOR FOR THE AUDIO FREQUENCY RANGE.

D.Brodhun.

Akust. Beihefte [Acustica], No. 1, 217-19 (1956). In German.

A convenient electrodynamic pick-up for measuring vibrations of radiating surfaces is described. The velocity sensitivity is constant from 60 to 5000 c/s. The low and high frequency limitations are discussed and the possibility of extending the range. Examples for practical use are given.

534.

19319 PROPERTIES AND EVALUATION OF REVERBERATIO CURVES. H.Kuttruff.

Akust. Beih. [Acustica], No. 1, 273-80 (1958). In German.

An exposition of reverberation phenomena in enclosed spaces i given and hence the characteristic bending of reverberation curves predicted. The slope at the commencement of such a curve is shown to be proportional to the weighted arithmetic mean of the damping factors of all the relevant natural vibrations. The conclusions which can be so drawn are illustrated by examples. The statistical deduction of the reverberation expression leads to the result that when the individual walls show different absorption possibilities, arithmetic averaging of the absorption factors ensues.

534.

19320 INVESTIGATIONS INTO PSEUDOSTEREOPHONY AND STEREOPHONY WITH A SPHERE-LOUDSPEAKER AND "ROOM-PRESENCE" EQUIPMENT. W.Kuhl and J.M.Zosel.

Akust. Beih. [Acustica], No. 2, 474-81 (1956). In German.

Various possibilities of obtaining a pseudostereophonic effect, i.e. a broad apparent source, with single-channel electro-acoustic reproduction are discussed, especially the possibilities of the so-called sphere-loudspeaker. Subjective tests have been carried out in which the effective distance of the listener from the loudspeaker was estimated. The ratio of direct to reflected sound agrees with the results of known experiments on the effect of delayed sound. In the two-channel reproduction of stereophonic sound the use of sphere-loudspeakers has advantages as well as disadvantages.

534.6

19321 THERMOELECTRIC MICROPHONE FOR MODULATED ULTRASONIC WAVES. R.A.Hanel.

J. Acoust. Soc. Amer., Vol. 32, No. 11, 1436-42 (Nov., 1960).

Conventional thermal microphones record the temperature increase generated by the absorption of acoustical energy. The microphone described in this paper measures the periodic change of the temperature that is generated by an amplitude-modulated sound wave. This microphone is small, omnidirectional, free of drift, and extremely sensitive. Temperature variations of the order of 3×10^{-5} deg C were recorded by means of a narrow-band amplifier tuned to the modulation frequency. The temperature distribution in a thermocouple enclosed in a sound-absorbing material, and the optimum modulation frequency are calculated. A relaxation on is introduced to help interpret the results physically. Also, ectronic input circuit is discussed in detail.

534.6 : 621.389

322 RESULTS FROM THE CONSTRUCTION OF AN ELECTRONIC ULTRASONIC IMAGE CONVERTOR.

eitag and H.J.Martin.

tica, Vol. 8, No. 4, 197-200 (1958). In German.

Deals with an ultrasonic iconoscope (image convertor) which, se of its electronic mode of operation, operates with a picture ency of 50 c/s without inertia, and has a relatively high sensi- , making it specially suitable for medico-diagnostic examina- .

534.6 : 621.395.61

323 SIMPLE CALIBRATION OF SMALL VIBRATION PICK-UPS. J.H.Janssen.

tica, Vol. 8, No. 3, 179 (1958).

The method uses a calibrated capacitor microphone, and covers ange 0.8 to 16 kc/s. A vibrating table (Cu disk, thickness , diam. 6 cm) is mounted at the top of a vertical travelling-wave (length 2 m, internal diam. 4.6 cm, with ρc-termination) and n axially by an electrodynamic vibrator. A rubber ring seals ap between disk and tube. The calibrated microphone is ted half-way down the tube. The pick-up is mounted on the outside the tube. Above 4.3 kc/s hydrogen must be used ad of air to eliminate higher modes which might be produced by symmetrically vibrating table. C.F.Pizzey

534.8

9324 DETERMINATION OF THE TRANSFER FUNCTIONS OF VIBRATION METERS AND STRUCTURE-BORNE SOUND K-UPS W.Mühe.

st. Beihefte [Acustica], No. 1, 220-3 (1956). In German.

Describes static, non-stationary, reciprocity and "vibration- e" methods of calibration, comparing them with other similar ces. Very small amplitudes are determined by means of a ier frequency method. Large sinusoidal motions have been ted down to 0.1 c/s. At those low frequencies it is possible to rmine the transmission function with a non-stationary method nalysing the transient phenomena.

534.8 : 539.19

19325 APPLICATION OF ULTRASONICS IN CONFORMATIONAL ANALYSIS. L.D.Bergel'son.

st. Zh., Vol. 5, No. 4, 391-402 (1959). In Russian. English nslation in: Soviet Physics—Acoustics (New York), Vol. 5, No. 4, -13 (April-June, 1960).

The possibilities of studying the internal rotation of molecules h the aid of ultrasound are discussed and the experimental data ained in this area are examined.

534.81

19326 MASKING EFFECT IN ORGAN SPECTRA. W.Lottermoser and F.J.Meyer.

ustica, Vol. 8, No. 6, 398 (1958). In German.

Discusses observations made earlier by Lottermoser (Abstr. 61 of 1954) with Baroque organs and modern organs. In ustration of the points raised in the discussion, curves are shown the masking of harmonic partials (a) for weak fundamental tone 0 c/s) and (b) for strong fundamental tone (260 c/s). The differen- s in the spectra of the partials in these two examples are scussed. A.B.Wood

534.81

19327 SUBHARMONICS AND PLATE TAP TONES IN VIOLIN ACOUSTICS. C.M.Hutchins, A.S.Hopping and F.A.Saunders.

Acoust. Soc. Amer., Vol. 32, No. 11, 1443-9 (Nov., 1960).

From the study of subharmonic series found in the violin and lated instruments, it is evident that the quality and loudness of e instruments depend on the pitch and variety of the subharmonic ries, and on the characteristics of the wood and the fashioning of e top and back plates. Details are given on the nature of sub- armonic series and their presence as observed in several methods testing. The single air tone is shown to consist frequently of wo or more closely related peaks. Observations made in a series f experiments carried on during the construction of 35 violins, iolas, and cellos indicate a method of controlling tone quality and olume of the completed instrument by means of the tap tones and e acoustic properties of the free plates. Experimental equipment which makes these findings possible is described in detail. With this concept of subharmonic series and the techniques described, a large field for experimental evaluation of string instruments may well be opened up.

534.8

19328 A STATISTICAL ANALYSIS TO TEST THE RELIABILI OF MEASURING ATMOSPHERIC NOISE SUBJECTIVEL BY A SMALL GROUP OF PEOPLE. B.B.Ghosh.

Indian J. Phys., Vol. 33, No. 10, 415-22 (Oct., 1960).

A statistical analysis of the results of some preliminary listening tests on the variation of judgement of different groups of listeners for the subjective measurement of atmospheric noise has been described. The possible limits of error committed by a comparatively smaller sample size or group of listeners as compared to that of a large group have been indicated and compare with those obtained from theoretical considerations. On the basis these findings, a practical procedure to meet the statistical requirement in employing a small group of eight observers for the actual measurement of atmospheric noise by a subjective method like that of Thomas, but suitably modified, for broadcasting servic has been discussed.

534.

19329 THE REDUCTION OF STRUCTURE-BORNE NOISE. J.C.Snowdon.

Akust. Beihefte [Acustica], No. 1, 118-25 (1956). In German.

A discussion of structure-borne noise originating from perio exciting forces, e.g. a motor vibrating in a vertical direction will excite its supporting structural girders. Such a finite impedance foundation possesses almost undamped natural modes which will respond in resonance, even to low energy excitation. The use of a two-stage compound mounting system to attenuate such structural exciting forces is described. The response ratio of a finite imped foundation is defined as the ratio of the displacement produced by resiliently mounted vibrating load to one rigidly mounted. Structu borne noise is a function of this ratio. Although high damping is a beneficial property of an isolating material, the rapid dynamic modulus rise with frequency associated with high damping synthet rubbers is most desirable. It is responsible for the majority of t isolation loss found for such materials at high frequencies.

534

19330 EXPERIMENTAL INVESTIGATION OF THE NOISE GENERATED BY THE TURBULENT FLOW AROUND A ROTATING CYLINDER. L.N.Wilson.

J. Acoust. Soc. Amer., Vol. 32, No. 10, 1203-7 (Oct., 1960).

The near- and far-field noise from the turbulent boundary lay developed on a rotating cylinder has been studied; both smooth an artificially roughened surfaces were employed. The cylinder wall were sufficiently thick to inhibit appreciably boundary-layer-excited vibration noise. The mean square pressure followed a U^4 law in the near field, and the total acoustic power radiated to the far field followed a higher exponent law: approximately U^6. The necessity to excise spurious peaks at harmonics of the cylind speed from the measured far-field spectrum introduced inaccura in the computed power law, bringing some doubt to bear on the accuracy of the exponent. The U^6 law, unless it is a fortuitous average of laws of lower and higher power, suggests that the dominant radiators are of a dipole type. Drag calculations from hot-wire measurements allowed an estimate of the efficiency (acoustic power/mechanical power) of the far-field radiation, res ing in an efficiency of the order of 30 times that for the quadrupol radiation from a jet at a Mach number of 0.228. Even so, the mea ured noise power from the boundary layer over a rigid wall appea to be relatively small in any practical application to the noise in aircraft. This is in contradistinction to the noise radiated by bou ary-layer-induced vibrations of a flexible wall or panel which can exceed the former by some orders of magnitude.

534.

19331 A STUDY OF THE ACOUSTIC FIELD IN ANECHOIC ROOMS. R.Lehmann and P.Brun.

Ann. Telecomm., Vol. 15, No. 5-6, 102-6 (May-June, 1960). In Fre

A brief review is given of the design of anechoic rooms, culminating in the present absorbant wedge treatment. Factors causing departures from free field conditions are residual reflections from the lining, floor grilles, microphone mountings, etc. T classical criterion is the closeness with which the 1/r law is ollowed. The wedge treatment and measurement of the new C.N.E.T. oom are described. A small pressure loudspeaker (2 cm) is made o generate substantially spherical waves at higher frequencies, a 0 mm diameter capacitor microphone being used. Some irregulariies on the traverse curve were due to the 4 cm floor slats. It is ecessary to make these narrower, as felt covering is ineffective. inal results are not given and it is not possible to assess the esolution of the measuring system at 10 kc/s. M.L.Gayford

534.84

19332 PROPAGATION OF STRUCTURE-BORNE SOUND IN BUILDINGS. W.Westphal.

kust. Beih. [Acustica], No. 1, 335-48 (1957). In German.

Simple methods for calculating the propagation of sounds in uildings are described and the influence of relevant parameters hown. An electric network based on the theory is built up. Various easurements on houses agree with the theory. In particular one ith a steel framework is found to give strong attenuation of structureorne sound in the vertical direction. The loss factors for different uilding materials (obtained from reverberation measurements) how only small differences.

534.84

19333 MEASUREMENTS ON THE PROPAGATION OF STRUCTURE-BORNE SOUND BY MEANS OF MODELS.

.Meyer.

kust. Beihefte [Acustica], No. 1, 51-8 (1956). In German.

After a short survey over the different wave forms in solids nd the experimental methods for the investigation of the propagation f structure-borne sound in models, the following subjects are reated: measurements of sound velocity and damping in solids; nfluence of changes in cross-section to the propagation of flexural aves; propagation of flexural waves around corners; effect of soft ntermediate layers; input impedance of plates for excitation at one oint; radiation of plates excited to flexural vibrations.

534.84

19334 CALCULATION OF STRUCTURE-BORNE SOUND PROCESSES. L.Cremer.

kust. Beihefte [Acustica], No. 1, 59-66 (1956). In German.

The different types of structure-borne sound waves occurring n an elastic continuum and in rods and plates are described. The ongitudinal waves can be treated as waveguides, but the flexural waves excite not only secondary waves, but also quasi-stationary near fields. These fields make total transmission and total isolation n the cases of elastic layers and impeding masses possible. The paper furthermore deals with corners, transition from rod to plate, mpact sound and its isolation by elastic coverings and floating floors.

534.84

19335 IMPACT NOISE — ORIGIN AND REDUCTION. K.Gösele.

kust. Beihefte [Acustica], No. 1, 67-72 (1956). In German.

Methods are described for the characterization of impact sound. The behaviour of different types of ceilings (homogeneous massive ceilings, hollow ceilings, double-layer ceilings) are studied with reference to the underlying physical principles. Isolation by floating floors is dealt with, discussing the different possibilities of transmission and the significant parameters (stiffness of the isolating ayer and of the enclosed air, flow resistance of the layer), and also he reduction of impact sound by elastic floor coverings, followed by discussion of the corresponding measuring parameters (mass of the hammer and shape of the striking surface).

534.84

19336 INVESTIGATIONS ON THE DAMPING OF STRUCTURE-BORNE SOUND IN ELASTICALLY MOUNTED BUILDING STRUCTURES. W.Kuhl and F.K.Schröder.

Akust. Beihefte [Acustica], No. 1, 73-8 (1956). In German.

In four broadcasting buildings and on some experimental structures measurements have been made in a large frequency band of the level difference of structure-borne sound between different walls and ceilings of the massive buildings as well as between these and the elastically mounted inner shell of the studio. Steel springs, cork, and fibrous materials have been used as elastic elements. The essential results are given and, to some extent, comparison is made with calculations. It is quite obvious that steel springs are by far superior to other elastic materials. Furthermore, the effect of insulation for structureborne sound on the transmission loss for airborne sound in the case of multiple walls and the audibility of different kinds of interfering noise is discussed.

534

19337 STRUCTURE-BORNE SOUND MEASUREMENTS IN A TALL BUILDING. W.Westphal.

Akust. Beihefte [Acustica], No. 1, 85-7 (1956). In German.

Propagation of structure-borne sound in a tall building has b measured both with continuous excitation and with pulses. The to losses have been determined by reverberation measurements, an the group velocity from measurements of the pulse propagation time.

534

19338 THE STUDY OF STRUCTURE-BORNE SOUND IN DWELLINGS. R.Martin and H.W.Müller.

Akust. Beihefte [Acustica], No. 1, 88-90 (1956). In German.

The accuracy of measurement of structure-borne sound in dwellings is discussed. For the method described it is sufficient to take the average of two sets of measurements having a mean deviation of 0.5 dB. From measurements of the decrease of structur borne sound in dwellings a strong dependence of the energy loss a branching points on the mass of the walls has been found. Furthe measurements of sound propagation in both horizontal and vertica directions in a eight-story building show clearly the partition of the branching points.

534

19339 MEASUREMENTS ON SOUND BRIDGES BETWEEN A PLASTER FLOOR AND A ROUGH COVERING.

M.Heckl.

Akust. Beihefte [Acustica], No. 1, 91-3 (1956). In German.

Predictions of the sound insulation of floating floors with sou bridges are in good agreement with the measurements. For the precalculation of the insulating effect the resistance of the floor a the covering and the transmission function of the bridge have to b measured. For sufficiently resilient sound bridges only one meas ment of the transmission function is necessary.

534.

19340 STRUCTURE-BORNE SOUND DAMPING USING GRANULAR MATERIALS. G.Kurtze.

Akust. Beihefte [Acustica], No. 1, 154-9 (1956). In German.

Discusses the following: damping of structural elements with and without sandfilling; experimental investigations of the frequen dependence of the damping; measurements of the input impedance a rigid vessel filled with different granular substances; conditions for effective damping of structural elements with granular substan

534.8

19341 ON THE TIME DEPENDENCE OF THE SOUND DIRECTIONAL DISTRIBUTION IN ROOMS FROM IMPULSIVE EXCITATION. E.Meyer and W.Burgtorf.

Akust. Beih. [Acustica], No. 1, 313-24 (1957). In German.

Two of the quantities determining the acoustical characteristi of a room, the directional distribution and the diffusiveness of sou energy, have hitherto been measured under steady-state condition In this work pulses were used to excite the room and the direction sound distribution was measured during the time of decay. As examples of the application of this method, the results of measurements carried out in two theatres are given. Of the two theatres one had smooth wall and ceiling surfaces, the other bounding surfaces giving strong acoustical scattering.

534.8

19342 INVESTIGATIONS INTO THE ACOUSTICS OF NUMEROUS CONCERT HALLS AND BROADCASTING STUDIOS, MAKING USE OF NEW METHODS. E.Meyer and R.Thiele

Akust. Beih. [Acustica], No. 2, 425-44 (1956). In German.

The following acoustical measurements were carried out in 31 different rooms ($V = 550$ to $22\,000\ m^3$): (1) measurement of the reverberation time as a function of the frequency; (2) recording of the reverberation curves with the "impulse glide method"; (3) measurement of sound pressure as a function of the frequency and calculation of the frequency irregularity; (4) recording of the directional distribution of the sound at 2 kc/s and calculation of the "directional diffusiveness"; (5) recording of the reflections of a sho pulse and measurement of the "50 ms energy part". The results of measurements show that only the methods 4 and 5, developed ling to the geometrical conception of room acoustics, give information for the judgement of the hearing conditions of a n place in a room than the reverberation time does. The tive significance of the observed phenomena has still to be d in detail by means of hearing tests carried out with suitable oacoustical methods. For this purpose the measured di- nal distributions and time sequences of the sound reflections e very useful.

534.84

343 ON THE DISTRIBUTION OF HIGH ENERGY SOUND REFLECTIONS IN HALLS.

G.R.Schodder.

. Beih. [Acustica], No. 2, 445-65 (1956). In German.

several broadcasting studios, concert halls, theatres and a h, the temporal succession of the sound reflections has been ded at a large number of positions. The oscillograms obtained analysed with respect to path time differences and intensities reflections, the levels of which are ≥10 dB relative to the of the primary sound. The reported results include: the dual numbers of the registered reflections falling at different for two halls, and for some halls and parts thereof the sponding mean numbers per seat, the distributions of the path differences of the registered reflections taken against the ar, sound and against the immediately preceding reflection, he distributions of the intensities of the reflections. Moreover, eneral influence of the position of the sound source on the re- ons was investigated, as well as the successions of the sound ctions which would be received by the one-channel transmission ms.

534.84

344 THE ACOUSTIC PROPERTIES OF THE LARGE AND THE MEDIUM SIZED HALLS OF THE NEW DERHALLE" IN STUTTGART.

emer, L.Keidel and H.Müller.

t. Beih. [Acustica], No. 2, 466-74 (1956). In German.

The asymmetrical form of the large hall for 2000 persons and coustical effect of its convex concrete wall near the strings, the shaped curve of the rear wall, and the profiles in horseshoe on below the ceiling are discussed. Registrations of shock- s in a 1/9 scale model and the use of light-rays for the design e canopies above the stage are also reported. Furthermore, entagonal shape of the smaller hall for 800 persons and the steps on the rising tiers of seats are discussed. Finally the rberation times of both halls are given.

534.84

9345 APPARATUS FOR THE AUTOMATIC EVALUATION OF SOUND REFLECTIONS.

W.Junius.

st. Beih. [Acustica], No. 1, 266-72 (1958). In German.

An electronic apparatus for room acoustical investigations is ribed. The apparatus evaluates the sound pressure of temporal essions of sound reflections and measures the energy for every ection. The number of reflections classified with respect to gy and delay time is registered.

534.84

9346 RANDOM AND SYSTEMATIC ERRORS IN AIR-BORNE AND STRUCTURE-BORNE SOUND MEASUREMENTS.

enzke, P.Dämmig and D.Reichow.

stica, Vol. 8, No. 5, 315-24 (1958). In German.

The discrepancies which are found in building acoustics asurements made by the Physikalisch-Technische Bundesanstalt T.B.) in Brunswick and those of other institutes have been in- tigated. By comparing these discrepancies with the repeated iations from the mean of observations, random and systematic ors have been found and their causes discovered.

A.B.Wood

534.84

19347 MEASUREMENT OF DIFFUSENESS OF THE ACOUSTIC FIELD IN ROOMS BY THE DIRECTIONAL MICRO- ONE METHOD.

V.V.Furduev and Chen Tun [Ch'êng T'ung].

ust. Zh., Vol. 6, No. 1, 107-15 (1960). In Russian. English nslation in: Soviet Physics — Acoustics (New York), Vol. 6, . 1, 103-11 (July-Sept., 1960).

A method is described for the measurement and quantitative ermination of the degree of diffusion of the sound field in closed rooms. The method is based on a comparison of the directivity characteristics of a measuring microphone when placed in a dead room and in the room to be investigated. The theory of measurements by means of a microphone in the form of a combination of a pressure pickup and pressure-gradient pickup is outlined. Some measurement results, obtained by the method described in a reverberation chamber and in radio broadcasting studios, are presented.

534.84

19348 SOUND INSULATION OF FRAME WALLS.

S.Ingemansson and T.Kihlman.

Chalmers Tekn. Högsk. Handl., No. 222, 47 pp. (1959).

534.84

19349 SOUND LEVEL IN ROUNDED CORNERS AND ANGLES [BETWEEN THE WALLS OF A ROOM].

G.Zimmermann.

Hochfrequenztech. u. ElektAkust., Vol. 68, No. 4, 122-5 (Nov., 1959). In German.

Theoretical considerations show that the sound pressures in a "corner" (where three walls or surfaces meet), in an "angle" (where two walls meet) and on a wall, are respectively $2\sqrt{2}$ (i.e. 9 dB), 2 (6 dB), and $\sqrt{2}$ (3 dB) times the pressure in the "free" space of the room. Relative to the sound pressure on the wall, the values for the "corner" and "angle" become 2× (6 dB) and $\sqrt{2}\times$ (3dB) respectively. All the above ratios of pressure amplitude relate to the cases where the corners and angles may be regarded as "sharp" (uncovered), i.e. the radius of curvature "r" is small compared with the wavelength "λ" of the incident sound. The paper gives the results of experiments in which the ratio r/λ is varied. A direct comparison is made, at each value of r/λ, of the sound pressure when the corner or angle is (a) uncovered (sharp) or (b) covered (rounded). Curves showing the ratio in dB of these pressures indicate that for $r/\lambda < 0.5$ there is no difference, whilst for $r/\lambda > 2$ the difference is 6 dB and 3 dB for corners and angles respectively. Between these values for r/λ there is a progressive change in the ratio.

A.B.Wood

534.84

19350 THE DAMPING OF "EIGENTONES" IN SMALL ROOMS BY HELMHOLTZ RESONATORS.

F.J. van Leeuwen.

E.B.U. Rev. A., No. 62, 155-61 (Aug., 1960).

The effect known as "boom" can be considerably reduced using resonators which are properly tuned and situated. The theory predicting this is presented, and the experimental verification is discussed, with some practical suggestions for the design and installation of resonators.

K.C.Garner

OPTICS . PHOTOMETRY

535

19351 COORDINATE TRANSFORMATION AND HUYGENS' PRINCIPLE.

G.Rehmann.

Optik, Vol. 17, No. 7, 383-90 (July, 1960). In German.

It is shown that the dynamic treatment of physical reference systems requires, in general, a dynamic transformation of which the kinematic Lorentz transformation is simply a special case. Huygens' Principle proves to be an anticipation of the dynamic transformation in the field of geometrical optics. General conclusions are drawn from the close analogy which emerges between mechanics and optics.

535.1

19352 STUDIES IN THE THEORY OF PARTIAL COHERENCE.

G.B.Parrent, Jr.

Optica Acta, Vol. 6, No. 3, 285-300 (July, 1959).

In a previous paper (Abstr. 8394 of 1959) several theorems were presented pertaining to the limiting forms of the mutual coherence function in quasi-monochromatic optical fields. In this paper these theorems are extended to polychromatic fields. In particular it is shown that: (1) an optical field is coherent if and only if it is monochromatic and its mutual coherence function is shown to be of the form

$$T(P_1, P_2, \tau) = U(P_1)U^*(P_2)\exp(2\pi i\nu_0\tau),$$

where U satisfies the Helmholtz equation; (2) an incoherent optical field cannot exist even if the illumination is polychromatic. However, an incoherent source is defined. Using these theorems the general Green's function-type solution for the propagation of mutual coherence from plane polychromatic sources is examined in detail in both the coherent and incoherent limits. In this way a complete generalization of the Van Cittert–Zernike theorem for polychromatic fields is obtained. From these theorems it is shown that, while a coherent source always gives rise to a coherent field, an incoherent polychromatic source gives rise to a partially coherent field.

535.1 : 530.12

EXPERIMENTAL PROOF OF THE SECOND POSTULATE IN THE SPECIAL THEORY OF RELATIVITY. See Abstr. 18922

535.21

19353 **RADIATION PRESSURE ON A RAPIDLY MOVING SURFACE.** R.Schlegel.
Amer. J. Phys., Vol. 28, No. 8, 687-94 (Nov., 1960).

The radiation pressure is calculated for a surface which is moving in an electromagnetic radiation field that is isotropic to a rest observer. In the limit where the velocity of the surface is that of light, the pressure is found to reach a maximum value 2u, where u is the isotropic electromagnetic energy density for the observer at rest. The finite value comes with an integration over radiation incident at all angles, even though radiation from a source which is directly approaching the surface has infinite momentum when the surface velocity reaches the speed of light. Estimates of radiation pressure in interstellar space lead to the result that the energy expended by a space-travelling vehicle in moving against electromagnetic radiation, at any possible speed, would be negligible.

535.21

19354 **MEASUREMENT OF RATIO OF ABSORPTIVITY OF SUNLIGHT TO THERMAL EMISSIVITY.** G.D.Gordon.
Rev. sci. Instrum., Vol. 31, No. 11, 1204-8 (Nov., 1960).

Direct measurements of the ratio of the surface absorptivity of sunlight to the thermal emissivity have been made, and the apparatus is described. A thin plate to be measured is suspended in a vacuum, surrounded by walls cooled by liquid nitrogen, and illuminated by an arc light, which simulates solar radiation. The desired ratio is determined from the equilibrium temperature, which ranged from 0° to 250°C for the samples measured. Possible errors in the procedure have been analysed theoretically, and corrections introduced where necessary. Intensity fluctuations in the present light source have limited the accuracy to 10%, but this is not a fundamental limitation in the method. Values of the thermal emissivity are also obtained from the rate of change of sample temperature.

535.22

19355 **SOME RECENT DETERMINATIONS OF THE VELOCITY OF LIGHT.** E.Bergstrand.
Nuovo Cimento Suppl., Vol. 6, No. 1, 224-31 (1957).

Reviews the measurements made in the decade 1947-1957, and comments upon the accuracy of the various methods. Geodimeter results are discussed in detail and are shown to be consistent with other methods. From all published results a "best" value of the velocity is determined. 26 references. R.W.Fish

535.22

19356 **SPEED OF LIGHT IN FLOWING DISPERSIVE LIQUIDS.** A.A.Evett and D.C.Fried.
Amer. J. Phys., Vol. 28, No. 8, 733-5 (Nov., 1960).

A general, rigorous method is presented for obtaining the equation for the speed of light in a flowing liquid. The derivation leads to an expression correct to all orders in the ratio of the speed of the liquid to the speed of light in a vacuum. The procedure used is based on establishing a differential equation which relates the light frequency to the speed of the liquid. Comparison is made between this general approach and the more usual approach. Limitations of the usual approach are discussed.

535.24

19357 **A HIGHLY-SENSITIVE MODULATION PHOTOMETER.** A.Yu.Borisov.
Optika i Spektrosk., Vol. 9, No. 1, 115-16 (July, 1960). In Russian.

Describes a photometer in which the d.c. signal from the photomultiplier is transformed (by a weak a.c. voltage applied to one of the dynodes) into an a.c. signal of double the applied frequency. makes it possible to separate out the useful signal from the leak currents through the insulation separating the photomultiplier electrodes. The modulated photomultiplier signal is fed to a tun resonance amplifier. The sensitivity of photometers with the sig modulation described above is one order of magnitude greater th that of photometers with d.c. amplifiers: it is possible to detect down to 50 photoelectrons per second from the photomultiplier cathode. A.Tybulev

535.24 : 5

THE PHOTOELECTRIC PHOTOMETER OF THE TURIN ASTRONOMICAL OBSERVATORY. See Abstr. 18586

535.24 : 52

A WOLLASTON PHOTOMETER. See Abstr. 16515

532

19358 **A STANDARD LIGHT-SOURCE FOR PHOTOELECT PHOTOMETRY BASED ON ČERENKOV RADIATION.**
T.S. van Albada and J.Borgman.
Astrophys. J., Vol. 132, No. 2, 511-12 (Sept., 1960).

The constant low-level light flux from this source is caused by the motion of relativistic electrons within a block of transpare plastic in which is embedded a dispersal of 1 mc of Sr^{90} in Ag '' (half-life 25 yr). The light output depends only on the refractive index of the embedding medium (Perspex), and the activity of the radioactive dispersion. Cherenkov radiation emanating from the medium is unaffected by ambient temperature and stray light. T colour of the emitted light is very blue (B-V = −0.2). D.R.Bar

GEOMETRICAL AND INSTRUMENTAL OPTI SPECTROSCOPY

(Optical spectra and their analysis are included under the appropriate heading, e.g. Atoms, Molecules, Solid-State Physics, etc.)

535

19359 **THE FORM OF THE GENERAL UNIMODULAR ANALYTIC SIGNAL.** S.F.Edwards and G.B.Parrent,
Optica Acta, Vol. 6, No. 4, 367-71 (Oct., 1959).

Finding the most general unimodular analytic signal is shown be equivalent to solving a singular integral equation of the Carlem type. This equation is solved utilizing the properties of analytic functions.

535.

19360 **REALIZATION OF A MEDIUM WITH A NEGATIVE ABSORPTION COEFFICIENT.**
V.K.Ablekov, M.S.Pesin and I.L.Fabelinskii.
Zh. eksper. teor. Fiz., Vol. 39, No. 3(9), 892-3 (Sept., 1960). In Russian.

A gaseous discharge in a mixture of mercury and zinc vapour is claimed to effect a realization of a medium with a negative absorption coefficient. This realization is attributed to resonance collisions of second order between excited atoms of Hg (7^3S_1) and ground-state atoms of Zn, which excite the latter to the 4^1D_2 level because of the near equality in energy of the two excited levels. F.A.Sanders

535.31 : 551

19361 **ON THE TRANSFER FUNCTION OF A NON-UNIFORM ATMOSPHERE.** J.V.Ramsay.
Optica Acta, Vol. 6, No. 4, 344-53 (Oct., 1959).

A discussion is given of the effect on telescopic performance an atmosphere which introduces a phase disturbance across the incident beam. The transfer functions for stationary and uniformly moving disturbances are deduced. Numerical examples are given for the case of a sinusoidal disturbance, and confirmatory experimental evidence is described.

535

19362 **CHARACTERISTIC FACTORS FOR DIFFUSE REFLECTION.** G.Bauer.
Optik, Vol. 17, No. 6, 315-29 (June, 1960). In German.

An attempt is made, taking account of current definitions, to e for all possible cases the most important measures of ctivity and to indicate the relationship between them. This ionship is based on the Helmholtz Reciprocity Law, the ity of which is assumed. With exception of diffuse reflectivity, uantities suggested in the new provisional standard DIN 5036 shown to be suitable, after certain additions, for the description l features of diffuse reflection. Another definition is given for se reflectivity which, in the author's opinion, has more general lity, particularly with regard to the application of the Recipro- Law.

535.31

19363 STRICTLY APLANATIC SYSTEMS WITH TWO SURFACES. B.Jurek.

ca Acta, Vol. 6, No. 3, 222-33 (July, 1959). In French.

The surface of strictly aplanatic singlets with object at ity are not spherical. The shape of the surfaces can be deter- ed by useful approximations. There are several exact methods mirror systems.

535.31

19364 A HIGH-POWER OBJECTIVE WITH SLIGHT ASTIGMATISM. M.Gaj.

ik, Vol. 17, No. 7, 365-82 (July, 1960). In German.

A new apochromatic lens—mirror objective with an aspheric face is computed. The correction of the aberrations is such t an angle of field of $2u = 20^\circ$ and a relative aperture 1 : 0.7 be attained for a focal length of $f' = -100$ mm. The angle of d is not limited by the astigmatism, which is so well corrected t a larger field would be possible but by the masking of the tral zone, which increases with field angle. The system can applied to photography of X-ray pictures, photography of terrain night and, in astronomy, to photography of sections of the sky. further special application is in meteor photography, as, for this rpose, the field of view can be increased.

535.31

19365 CONTRAST TRANSMISSION FUNCTION AND IMAGE QUALITY. G.Franke.

tica Acta, Vol. 6, No. 4, 208-19 (Oct., 1960). In German.

The connection between geometrical aberrations, the distribu- n of light in the image of a point or a line and the contrast ansmission function is derived for an axial image, leading to a scussion of the best focal position. Confirmation is obtained of the perimental result that, for daylight photography at the image ntre, the best setting is obtained when the normal aberration rves have the minimum distance between their tangents parallel the axis of abscissae. Opposite assertions that the best position obtained by minimum spread of light, rest on an approximation hich is not generally valid. For commercial objectives the latter iterion can give a focal position differing significantly from the otimum.

535.31

19366 CONTRAST TRANSMISSION FUNCTIONS AT LOW SPATIAL FREQUENCIES. E.H.Linfoot.

ptica Acta, Vol. 6, No. 4, 387-403 (Oct., 1959).

The relations existing at low spatial frequencies between the ay-theoretic ct-function t of an optical system and the more exact t-function τ predicted by the usual scalar wave model based on Huygens' principle are investigated by sharpening and extending recent analysis due to Miyamoto (Abstr. 5748 of 1958, 1239 of 959). An approximate expression is obtained for the difference etween t and τ, together with an explicit upper limit for the error of pproximation in terms of the wave aberration of the system. This main result is shown to yield quick and easy proofs of most of the nown results concerning the relations between the radial first and second derivatives of t and τ at the origin with each other, with perture diffraction, and with the radius of gyration of the ray- heoretic image about the origin of coordinates. It is shown that the bove-mentioned scalar wave model has the following property: he increase, due to aberrations, in the moment of inertia of the diffraction image about any point in or near to its bright central region is equal to the increase in the moment of inertia of the ray- heoretic image about that point. The result is of some interest because of its formal equivalence to a statement of Duffieux C.R.Acad. Sci. (Paris), Vol. 225, 1257 (1948) and Abstr. 6359 of 1952] about the physical light distribution, although it does not suffice to prove that statement.

535.31

19367 CONTRAST TRANSMISSION AND THE IMAGE EVALUATION PROBLEM. E.H.Linfoot.

Optica Acta, Vol. 7, No. 1, 65-80 (Jan., 1960).

A discussion is given, with the help of contrast-transmission theory, of the relative merits of the ray-theoretic moment of inertia, of the Strehl definition, and of the so-called photographic Strehl definition as quality evaluations of astrographic cameras and of camera lenses producing images with the familiar core-and-halo structure. The "interferometer quality" assessment of Coleman et al. (Abstr. 3494 of 1947) is also considered. The general discussion is supplemented by a fairly detailed examination of the effects of applying the second and third evaluations to a system with primary spherical aberration. It is concluded that, when when a system with primary spherical aberration forms images with a core-and-halo structure, the image quality near best focus depends critically on the properties of the image core, where diffraction effects may be dominant even when the total wave aberrations are large, and the inference is drawn that in evaluating the performance of a photographic system forming core-and-halo images the photographic Strehl definition should prove much more satisfactory than either the classical Strehl definition or the ray-theoretic moment of inertia. For the performance evaluation of astrographic cameras, on the other hand, use of the ray-theoretic moment of inertia seems to be a satisfactory practical procedure.

535.31

19368 THE PROBLEM OF OPTIMUM OPTICAL SYSTEMS. R.S.Ingarden.

Optica Acta, Vol. 7, No. 2, 179-83 (April, 1960).

A new definition of the entropy of the light intensity distribution in the object and image planes of an optical system is formulated. A definition of classes $C_{m}n$ of optical systems and a definition of the optimum system in each class for a given object point are also given. For finding the optimum system in a class $C_{o}n$ an extremal problem is formulated and in a class $C_{m}o$ a variational problem (in the general case of a class $C_{m}n$ two types of problems occur). When an optical system is non-conservative (the light energy in the object plane is not equal to the light energy in the image plane), the variational problem is composite.

535.31 : 77

19369 SIGNIFICANCE OF THE RAY-OPTICAL APPROXIMATION AND ITS APPLICATION TO THE VALUATION OF PHOTOGRAPHIC IMAGE CHARACTERISTICS. E.Heynacher.

Optik, Vol. 17, No. 3, 160-7 (March, 1960). In German.

A comparison is made of the intensity distribution in the image of a point, derived in accordance with the principles of geometrical optics and wave optics, respectively, for an example typical of the conditions of photographic imagery. It is shown that the differences between the distributions in the two cases are considerably reduced if the frequency range is restricted to that important for photographic imagery and the influence of the photographic emulsion is taken into account. Images of extended objects, obtained by means of an optical analogue apparatus, are shown for different conditions of union of the rays, which are indicated by spot diagrams.

535.31 : 77

19370 SPECTRAL ANALYSIS OF PHOTOGRAPHIC IMAGES. Aebischer-Néoschil, Gaultier du Marache, P.M.Duffieux, J.C.Viénot and W.J.Obert.

Optica Acta, Vol. 7, No. 1, 1-19 (Jan., 1960). In French.

In the photographic recording of an optical image, limitations due to the properties of the sensitive material, processing, etc., do not allow an exact representation of the object. Useful overall information can be derived from a domain of spatial frequencies which is always limited. Some methods of investigating Fourier spectra of photographic images are presented. Results and comparisons are given in a particular case. Performance of an interference periodograph is improved by using for the image domain to be analysed pupil functions converging uniformly and rapidly. The possibilities of such functions are shown, as well as practical realizations of corresponding soft edge pupils.

35 31

19371 SOME OBSERVATIONS ON THE PROBLEM OF OPTICAL IMAGE QUALITY ASSESSMENT E.Heynacher.

Optica Acta, Vol. 7, No. 2, 173-8 (April, 1960)

The assessment of image quality is discussed in terms of various criteria and methods. In particular, the difficulties are examined which arise from the properties of image transfer through the human eye.

535.31

19372 IMPROVEMENT OF ABERRANT IMAGES BY MEANS OF SPATIAL FREQUENCY FILTERING. J.Tsujiuchi.

Optica Acta, Vol. 7, No. 3, 243-61 (July, 1960). In French.

The improvement of an image spoilt by the aberration of an objective is studied. An experiment with the image given by an objective whose response function is a Gaussian curve of one dimension is shown.

535.31

19373 THE OPTICAL IMAGE DEFECTS AND THE TRANSMISSION FUNCTION.

K.Rosenhauer and K.J.Rosenbruch.

Optik, Vol. 17, No. 5, 249-77 (May, 1960). In German.

The combined effect on the image of all image defects or aberrations, as well as the infuence of diffraction, can be expressed in terms of the complex contrast transmission function (C.C.T.F.). It is possible to measure to the C.C.T.F. directly and also to determine the abberations. The effect on the C.C.T.F. of the known image defects over the image field can be recognized from these measurements. In this way, the effect of spherical and chromatic aberration, field curvature, astigmatism and coma has been investigated for different optical systems with focal lengths between f = 4 mm and f = 200 mm. As the C.C.T.F. of the various stages in the imaging process can be combined, it is a simple matter to deduce from the C.C.T.F. function a criterion of quality for the optical system under investigation for any given conditions of imagery. By contrast, the calculation of these relations from the aberrations alone is tedious, and is indeed only possible for certain special conditions of imagery.

535.31

19374 BRIGHTNESS COMA AND DIAPHRAGM COMA IN ROTATIONALLY-SYMMETRIC OPTICAL SYSTEMS.

P.Sindel.

Optik, Vol. 17, No. 6, 289-314 (June, 1960). In German.

Necessary and sufficient conditions are deduced for the requirement that the brightness distribution (according to geometrical optics) in the images of radiating object surface elements, situated on the axis and infinitely close to it, be equal when the diaphragm is fully open. They must be satisfied for the "spherical" rays in the meridian plane which leave the axial point of the object plane. The necessary and sufficient condition for the disappearance of "brightness-coma" must be satisfied for all the spherical rays passing through the diaphragm. In addition, the necessary and sufficient condition for the disappearance of "diaphragm-coma" must be satisfied for the spherical ray touching the edge of the diaphragm. Ignoring certain special cases of no importance, measures for the residual brightness-coma and diaphragm-coma are introduced, which have the evident significance of a difference of magnification for the annular surface elements of different brightness (taken individually in the case of multiple covering) and for the circle of intersection of the edge rays with the image plane. The necessary and sufficient conditions which must be satisfied in order that the intersection lines of the caustic together with the intersection line of the edge rays (with fully opened diaphragm) maintain strictly circular symmetry, are indicated to a first approximation for small object heights.

535.31

19375 ON THICK LENSES. I. SPHERICAL ABERRATION. M De.

J. Assoc. Appl. Physicists, Vol. 4, No. 4, 175-83 (Dec., 1957).

Analytical expressions have been developed to obtain spherical aberration of a single thick lens in air. The dependence of the aberration on the thickness has been studied, and a parameter D is introduced, which is shown to be given by

$$D = \frac{X}{\mu} - \frac{\mu - 1}{\mu} Y.$$

The equivalence between a thin and a thick lens is more conveniently made use of in terms of this parameter. Some useful results and conditions for minimum and zero spherical aberration of a thick lens have been obtained.

535.3

19376 SIMULATION OF PRIMARY ABERRATIONS OF A LEN USING A GENERALIZED MICHELSON INTERFEROMETER. M.V.R.K.Murty.

J. Opt. Soc. Amer., Vol. 50, No. 11, 1089-1102 (Nov., 1960).

The Michelson interferometer in its more generalized form is shown to be an analogue of a lens suffering from primary aberrations. This is a true analogue in the sense that no test lens is needed, except insofar as certain lenses form part of the interferometer. By suitable modification it could be made to simulate primary spherical aberration, primary astigmatism, and primary coma.

535.32 : 538.5

19377 A SIMPLE DERIVATION OF THE KRAMERS—KRONIG RELATIONSHIPS. V.S.Galishev.

Optika i Spektrosk., Vol. 8, No. 3, 417-19 (March, 1960). In Russia

Uses published work to derive in a simple fashion the Kronig relationship between the refractive index and the absorption coefficient and the Kramers relationship between the real and imaginary parts of permittivity. A.Tybulewic

535.3

19378 [REFLECTION AND TRANSMISSION] PROBLEM OF A PILE OF PLATES. A.Kawski and A.Skwierz.

Optik, Vol. 17, No. 4, 203-7 (April, 1960). In German.

The Lunelund recurrence formulae and Stokes equations expressing the total reflected and transmitted intensity for a pile of plates are modified.

535.32

19379 THE DETERMINATION OF THE REFRACTIVE INDICES [n] OF NON-OPAQUE MINERAL SUBSTANCE USING THE POLARIZATION ANGLE. H.Schumann.

Nachr. Akad. Wiss. Göttingen, math.-phys., Kl. IIa, 1960, No. 8, 167-72. In German.

The Brewster angle may be measured on a reflecting goniometer; a microscope permits the use of specimens down to 0.1 mm so that the surface structure of a mineral may be examined. In favourable cases measurements of n are reliable to within 0.001. G.F.Lothian

535.32

19380 MEASUREMENT OF REFRACTIVE INDEX OF A TRANSPARENT FILM ON A REFLECTING SUBSTRATE

J.C.Kelly and O.S.Heavens.

Optica Acta, Vol. 6, No. 4, 339-43 (Oct., 1959).

A method is described which uses the Brewster angle method to measure the refractive index of transparent films on reflecting substrates. The strong background reflection from the substrate is eliminated by scanning the filmed and bare parts of the substrate and adjusting the angle of incidence till the modulation is a minimum The method is applied to anodic oxide films on tantalum and an increase in apparent index of refraction with increasing oxide thickness found.

535.32

19381 COLOUR CORRECTION IN OPTICAL SYSTEMS AND A NEW DISPERSION FORMULA. M.Herzberger.

Optica Acta, Vol. 6, No. 3, 197-215 (July, 1959).

The author's interpolation formula for computing the dispersion of glass and other optical materials has been improved. If four data are given for a glass, for instance the index n_F, dispersion $(n_F - n_C)$ and the partial dispersion in the infrared and ultraviolet, the indices for any wavelengths can be computed. Four diagrams obtained by plotting two of the data against each other describe the optical qualities of the glass. Three glasses on a straight line in the plot of infrared partial dispersion against ultraviolet partial dispersion lead to a cemented triplet practically corrected from 0.365 μ to 1.01 μ.

535.8 : 612.8

19382 AN OPTICAL ILLUSION AFFECTING INSTRUMENT CROSS-WIRES. S.Tolansky.

Lab. Pract., Vol. 9, No. 9, 635-7 (Sept., 1960).

A description is given of an optical illusion which confuses the estimate of colinearity when inclined lines cross a broad image. The nature of the illusion is examined and found to depend on (a) angle of inclination of the crossing lines and (b) the width of the object. The way in which this illusion might affect cross-wire settings is considered. S.Tolansky

535.8

9383 DOES THE TELESCOPE ENLARGE OR APPROACH?

V.Ronchi.

Inst. Politeh. Iasi, Vol. 5,(IX), No. 3-4, 87-94 (1959).

A consideration of mental processes occurring during the use telescope leads to the view that the instrument neither enlarges approaches an object. It increases the retinal image, the rest g a matter of interpretation. R.A.Weale

535.8

19384 A NEW MICROMETER MICROSCOPE.

R.Barer.

ure (London), Vol. 188, 398-9 (Oct. 29, 1960).

Measurement of the size of particles in a microscope against eyepiece scale is tedious and often inaccurate. A new system is scribed in which two images are seen, sheared by a known ount. Particles whose diameter equals the shear will just touch, se smaller will appear as two distinct objects, while layer ticles will overlap. An attachment to a standard microscope is scribed. This allows the shear to be controlled in amount and ection, so allowing the measurement of irregular shaped objects. R.W.Fish

535.8

19385 MORE CHRISTIANSEN FILTERS.

L.Auerbach.

er. J. Phys., Vol. 28, No. 8, 743 (Nov., 1960).

An extension of previous work see Abstr. 582 of 1958.

535.8

19386 MICROSCOPE HOT STAGES.

G.J.Dean.

cuum, Vol. 7-8, 90-3 (1957-58: publ. April, 1959).

535.8

19387 ON THE INFLUENCE OF THICKNESS AND TEMPERATURE ON THE "CUT-OFF" CHARACTERTICS OF GLASS FILTERS.

A.K.Ångström and A.J.Drummond.

art. J. Roy. Meteorol. Soc., Vol. 85, 429-31 (Oct., 1959).

Schott glass filters OG1, RG2 and RG8 were investigated with spect to the dependence of the lower sharp wavelength "cut-off" filter thickness and temperature. Typical values of the main t-off characteristics are tabulated.

535.8

19388 A NEW OPTICAL METHOD FOR WIDE ANGLE TRACKING. II.

J.N.Whyte.

strum. Pract., Vol. 14, No. 10, 1073-7 (Oct., 1960).

A general description of the properties of an optical element, esignated the "prismor" (comprising a double prism with silvered terface) was given in Pt I (Abstr. 8781 of 1960). The present rticle deals with some of the possible applications of the element.

535.8

19389 OPTICAL CHARACTERISTICS AND PHYSICAL PROPERTIES OF FILLED-EPOXY MIRRORS.

.H.Saxton and D.E.Kline.

. Opt. Soc. Amer., Vol. 50, No. 11, 1103-11 (Nov., 1960).

This paper describes a process of production of high-quality luminium-filled epoxy replica mirrors using a glass master in two-step process. From photometric data using a circle-of-conusion tester, optical data is given which evaluates the performance f these mirrors, cast by different methods and subjected to various nvironmental conditions. The data indicate that the mirrors can ndergo significant thermal shock, thermal cycling, nuclear radiaion, and change in moisture content without being severely degraded. Results of research on some of the physical properties of polymerized epoxy resins, which are pertinent in design and application of he mirrors, are presented.

535.8

19390 IMPROVEMENTS TO THE CHALONGE MICROPHOTOMETER.

A.Ganson and M.Montel.

J. Phys. Radium, Vol. 19, Suppl. No. 12, 171A-175A (Dec., 1958). In French.

Optical and mechanical modifications are described, which allow the study of spectra of large size, recorded on large-grain plates. With the new optical system, slit images 25 mm high and uniformly illuminated are given on the plate. With the help of several new mechanical additions, the object-slit can be adjusted continuously, and better precision is obtained in the relative orientation of the slits and the plates. The addition of a new diaphragm allows operation with a constant flux without shifting the colour temperature of the lamps. Three studies on particular cases have been made, in order to evaluate the effects of the improvements on the reproductibility and resolving power of the apparatus.

535.8 : 537.7

19391 FILM CARRIER FOR THE ANALYSIS OF OSCILLOGRAMS BY MEANS OF A TRAVELLING MICROSCOPE.

T.M.Parnell.

J. sci. Instrum., Vol. 37, No. 11, 441 (Nov., 1960).

Describes a method of analysing oscillograms of voltage and current pulses on 35 mm film by means of a 2-coordinate travelling microscope. Illustrated details are given of the apparatus and mode of assembly.

535.8

19392 PHOTOMETER FOR LUMINESCENCE.

J.Saddy.

J. Phys. Radium, Vol. 19, Suppl. No. 12, 183A-184A (Dec., 1958). In French.

Light from a tungsten ribbon filament passes through two polarizing prisms with a thin quartz plate between them, so arranged that the emergent polarized beam is of similar colour to the phosphorescence being measured. Using a photometer cube and an analyser to reduce the intensity of the standard beam, phosphorescence can be measured during its rapid fall and up to periods of several hours. S.T.Henderson

535.8 : 539.2 : 535.37

19393 A NEW MEASURING SYSTEM FOR QUANTUM EFFICIENCY MEASUREMENTS OF LUMINESCENT SUBSTANCES.

G.T.Bauer.

Acta phys. Hungar., Vol. 11, No. 3, 225-34 (1960).

Using a shaped mask along with the exit slit of a monochromator, a combination of monochromator, mask, and detector was assembled. The system as a whole had a sensitivity proportional to wavelength between 4000 and 6900 A, making it possible to measure directly the quantity $k\int_{\lambda_1}^{\lambda_2}\lambda I(\lambda)d\lambda$ for either the exciting beam or the luminescent output of a phosphor, where $I(\lambda)$ is the spectral distribution and k is a constant. Thus with two simple measurements the quantum efficiency

$$\eta = \frac{\int_{a'}^{b'}\lambda I_e(\lambda)d\lambda}{\int_{a}^{b}\lambda I_{Ex}(\lambda)d\lambda} = \frac{\int_{a'}^{b'}\frac{I_e(\nu)}{\nu}\,d\nu}{\int_{a}^{b}\frac{I_{Ex}(\nu)}{\nu}\,d\nu}$$

can be obtained. The author has obtained quantum efficiency figures for willemite, magnesium tungstate, cadmium borate, and calcium halophosphate. The last two values are in good agreement with measurements made by Bodo (1953). I.Cooke

535.8 : 532.7 : 535.37

19394 MEASUREMENT OF THE EMISSION ANISOTROPY OF FLUORESCENT SOLUTIONS.

B.Polacka.

Optik, Vol. 17, No. 4, 208-12 (April, 1960). In German.

An experimental check of the formulae for the anisotropy of emission in the compensation method of Arago for two and three glass plates was made. Use was made of the method of calibration due to Weber (1952) for two different refractive indices of the glass plates. It is shown that there is good agreement between theory and experiment and that the degree of anisotropy of emission can be measured for higher refractive indices of the glass plates. The anisotropy of emission from fluorescent solutions can therefore be calculated on the basis of theoretical formulae. In this case, calibration of the set of glass plates is not necessary.

535.8 : 545

19395 CALCULATION OF THE ERRORS OF AN ABSORPTION ANALYSER OF GAS OR LIQUID MIXTURES.

A.O.Sali'.

Optika i Spektrosk., Vol. 8, No. 4, 571-3 (April, 1960). In Russian.

To reduce the errors of absorption analysis, the calibration flux can be made equal to the non-absorbed flux by varying the thickness of a cell in the calibration beam. The concentration of a given component in a mixture is then deduced from the thickness of the calibration cell. The relative error with such an arrangement in an optico-acoustic analyser with gas compensation was of the order of 2-3%, when the measured optical density was 0.5 and the radiation flux was reduced by half due to absorption by a component whose concentration was to be found. A.Tybulewicz

535.8

19396 THE PRODUCTION OF A TEST CHART WITH SINUSOIDAL DENSITY BY FILTERING OF SPATIAL FREQUENCIES. R.Desprez and J.Pollet.
C.R. Acad. Sci. (Paris), Vol. 251, No. 5, 674-6 (Aug. 1, 1960). In French.

A photographic test chart with sinusoidal variations of density is produced from a chart with repeated patterns of variable area. The latter is projected by a lens with a shaped mask in its entrance pupil on to the photographic plate. The requirements to be met in obtaining a true sinusoidal pattern as discussed. R.W.Fish

535.8

19397 VALIDATION OF SINE-WAVE ANALYSIS FOR PHOTOGRAPHIC SYSTEMS.
G.C.Higgins, R.L.Lamberts and R.N.Wolfe.
Optica Acta, Vol. 6, No. 3, 272-8 (July, 1959).

It is shown that, if the luminance range is not excessive ($\Delta \log B = 0.5$ in the case considered), the edge trace in the print can be satisfactorily computed from the sine-wave responses of the lens, the negative film, and the positive film. A device was made to "photograph" a transparency with a uniform spread function over the entire picture area. Nine photographs made with different spread functions were evaluated psychometrically for definition and the corresponding sine-wave responses were determined. A plot of definition against equivalent passband shows that, although the latter may be useful in estimating the definition to be expected in a picture, it (or probably any single number) should be used with caution and may even be misleading.

535.8

19398 A METHOD OF TESTING OPTICAL FLATNESS OF PRE-POLISHED GLASS SURFACES.
A.S.Hameed and S.Hariharan.
J sci. industr. Res., Vol. 18A, No. 7, 311-13 (July, 1959).

A method for the quantitative estimation of the form of an optical surface, just before polishing, is described. The optical layer with suitable modifications is used for the purpose, so that departures from a standard form, say an optical flat, can be evaluated in terms of wavelengths of light. This data will be helpful in correcting surfaces even in the pre-polishing stages. The time spent in effecting the corrections at this stage will be very much less than the time taken in the figuring stages, after polishing. The results obtained were verified by interference methods.

535.8

19399 USE OF A VISUAL METHOD FOR THE MEASUREMENT OF THE CONTRAST FACTOR OF AN OBJECTIVE.
J.Simon.
Optica Acta, Vol. 6, No. 3, 279-84 (July, 1959). In French.

An attempt has been made to devise the simplest possible apparatus for the study of the transmission of spatial frequency in an optical system. The most suitable receptor seems to be the eye, which can match to a high precision the equality of contrast of two juxtaposed fields of view. A procedure has been used which allows of a continuous known variation of image contrast while maintaining constant the mean illumination. The system makes possible the study of a wide range of frequencies, and notably the high frequencies.

535.8

19400 A METHOD FOR QUICKLY TESTING THE PERFORMANCE OF OBJECTIVES.
F.Below and H.Grabke.
Optica Acta, Vol 7, No. 2, 113-20 (April, 1960). In German.

The measurement of the light distribution in slit images proves to be a practical method for a quick examination of optical systems. The widths of the slits and the magnification can be chosen so that the spatial frequencies in the image correspond to the principal time frequencies in the video-region of 1-10 Mc/s. The limit of the frequencies can be obtained by the steepness of the slope in the oscillogram. A special arrangement permits a more precise measuring of the phase error from the asymmetric curves. The influence of the optical system on the television image may be studied by the additional use of suitable low frequency filters.

53

19401 THE TOLERANCE SOLID OF AN OPTICAL SYSTEM FUNCTIONING AT LOW SPATIAL FREQUENCIES.
J.Pastor.
Optica Acta, Vol. 7, No. 2, 159-72 (April, 1960). In French.

A general condition has been found for the tolerances of all types of aberration in an optical system for low spatial frequenci using Hopkins' method and criterion. The results are applied to photographic objective and to an instrument for night vision. The tolerances in this case are found by multiplying those for daylight vision by a factor depending on the object contrast. Experimental verification of the results is given. The application of these tolerances in optical calculation suggests that an improvement is possible in the photometry of instruments by using simpler syste without loss of definition.

53

19402 VARIATION OF RESOLVING POWER AND TYPE OF TEST PATTERN. F.E.Washer and W.P.Tayman.
J. Res. Nat. Bur. Stand., Vol. 64C, No. 3, 209-23 (July-Sept., 1960

The plane of best average definition is located for a number o lenses of a type used in airplane mapping cameras. Three differe types of test pattern are used for each lens. These patterns are t long-line, short-line, and annulus. Results of measurement that show the variation of resolving power throughout the region of usable imagery are given for each type of test pattern with two typ of photographic emulsion. It is found that the plane of best averag definition can be located equally well with each type of pattern. There are, however, pronounced differences in the numerical mag tudes of the values of resolving power determined with the various types of test pattern. In general, the highest values are attained with the long-line patterns. Values of the various rating indices $\sqrt{R_\beta T_\beta}$, AWAR (area weighted average resolution), and ADWAR (area and depth-of-focus weighted average resolution) are given together with a comparison of the different order of merit assigne by these indices.

535

19403 SOME INVESTIGATIONS ON THE TRANSMISSION FUNCTION. H.Kubota, K.Miyamoto and K.Murata.
Optik, Vol. 17, No. 3, 143-51 (March, 1960). In German.

In order to test the performance of an instrument constructed by Murata [J. appl. Phys. Japan, Vol. 28, 245 (1959)] for the measu ment of the frequency response of optical systems, the transmissi (response) functions measured for two lenses were compared with their calculated values. The transmission functions were calculat using the principles of geometrical optics from the spot-diagram by means of the formula developed by Miyamoto and by Lukosz. A electronic computor was used for the calculations. The agreement between the calculated and measured results indicated that the instrument functions satisfactorily. It is suggested that the depth focus of a lens is the region for which the area under the transmission function

$$\int_0^\infty R(r)dr = Q$$

is not less than a certain value. Numerical examples are given in the case of the two lenses measured.

535.

19404 AN APPARATUS FOR MEASURING TRANSMISSION FUNCTIONS OF OPTICAL SYSTEMS. K.Murata.
Optik, Vol. 17, No. 3, 152-9 (March, 1960). In German.

A method for the measurement of transmission (response) functions of an optical system is described. A Foucault grating with varying grating constant is used and moved by a cylindrical cam with varying velocity. Higher harmonics of the grating are eliminated electrically by a low-pass filter. A pulse circuit is employed for phase detection. By means of this apparatus, the modulus and the phase of a transmission function are measured in less than 1 min.

535.

19405 CONNECTION BETWEEN THE LIGHT PEAK [LICHTGEBIRGE] AND THE INCOHERENT TRANSMISSION FUNCTION. E.Heynacher.
Optica Acta, Vol. 6, No. 3, 266-71 (July, 1959). In German.

A method is described, suitable for the case of imagery with incoherent illumination, of evaluating the Fourier transform of a given function. The function is expressed in terms of components whose transforms are known, and the transform of the function is ed as the sum of the transforms of the components. An le is given of the application of the method.

535.8

406 MEASURING THE TRANSMISSION PHASE BY MEANS OF THE GRATING TEST METHOD.

senhauer and K.J.Rosenbruch.

a Acta, Vol. 6, No. 3, 234-51 (July, 1959). In German.

method is described for the measurement of the complex mission function of optical systems, and results are presented ome miniature camera lenses. In general the real part of the lex transmission function which is the usual contrast transion function gives an adequate description of the imagery. The inary part, which describes the phase displacement, only nes important when the contrast transmission function falls 0.2. The assessment of the effect on the image quality of e types of image defects, e.g. coma or field curvature, requires wledge of the phase effect.

535.8 : 539.12

9407 THE FUNDAMENTAL LIMITS OF INFORMATION CONTENT IN SOLID STATE IMAGE INTENSIFYING ELS COMPARED WITH OTHER INTENSIFYING SYSTEMS.

Fowler.

. J. Radiol., Vol. 33, 352-7 (June, 1960).

The minimum perceptible contrast (m.p.c.) is derived for four ems of X-ray image intensification by considering the number uanta available at each stage. The systems are (1) the conven- al fluoroscopic screen; (2) the combined photoconductor- troluminescent panel; (3) the vacuum tube image intensifier; the television system including (1) and an image orthicon. For ntegrating time of 0.2 sec the m.p.c. is 75, 11, 16 and 9% pectively, while if storage is admitted over 2 sec, with presen- on of successive still pictures, system 4 improves to 5% and tem 2 to 7%, which is reduced to 5% by operation at 400 c/s to higher brightness. System 2 has slow build-up and decay rates: former is shown graphically at various dose rates; operation h storage is very suitable for this system. S.T.Henderson

535.8 : 539.12

19408 THE PROSPECTS FOR SOLID STATE INTENSIFYING SCREENS. S.T.Henderson.

it. J. Radiol., Vol. 33, 357-8 (June, 1960).

A brief account of an X-ray intensifying screen consisting of ntiguous electroluminescent and photoconductive layers with an . potential applied overall, and of several possible uses particu- ly in surgical and radiotherapeutic procedures.

S.T.Henderson

535.8 : 539.16

19409 THE RADIOACTIVITY OF OPTICAL INSTRUMENTS WITH COMPONENTS OF POTASSIUM BROMIDE.

Braunbeck.

aturwissenschaften, Vol. 47, No. 15, 353 (1960). In German.

Optical instruments containing KBr are sources of radio tivity, arising from K^{40} which is present as 0.012% of natural otassium. Measurements on typical instruments are reported and afe distances between such instruments and Geiger counters are uggested. R.W.Fish

535.8

19410 DESIGN OF THE CHAMBER FOR A BARO-OPTICAL SOURCE OF RADIATION. A.O.Sall'.

ptika i Spektrosk., Vol. 8, No. 5, 731-3 (May, 1960). In Russian.

Derives a design formula for calculation of the depth of a hamber for a selective source of modulated radiation which uses mission by a gas whose temperature is varied periodically by lternate compression and expansion. A.Tybulewicz

535.8 : 541.18

SMOKE DENSITY INTEGRATOR. See Abstr. 18446

535.8 : 536.3 : 621.83 : 621.317.39

OPTICAL TECHNIQUES IN THE OPERATION OF INFRA-RED DETECTORS. See Abstr. 19498

535.33

19411 EXTENSION OF THE CONCEPT OF FOURIER SPACE TO SPECTROSCOPY. P.Jacquinot.

Optica Acta, Vol. 7, No. 3, 291-303 (July, 1960). In French.

The application of the concept of Fourier space, familiar in communication theory, to the field of optical imagery is described. The correspondence of the different variables and functions is discussed for the cases of coherent imagery, imagery by wave-front reconstruction, and incoherent imagery. A relationship is established between imagery by wave-front reconstruction and the new spectroscopic method in which the spectrum is reconstructed by the Fourier transformation of the interferogram obtained by a double beam interferometer. This relationship clarifies the essential characteristics of the method. In particular when the Fourier transform is obtained numerically from a number of equidistant points in the interferogram, a superposition of spectra is obtained, similar to that given by a grating or a Fabry—Perot: the effect is analysed by comparison with the imagery of a monochromatic object by a grating. The relationship is discussed between different methods of spectroscopy and typical optical imagery.

535.33

19412 THE RAMAN SCATTERING INDICATRIX. I.I.Kondilenko, P.A.Korotkov and V.L.Strizhevskii.

Optika i Spektrosk., Vol. 8, No. 4, 471-6 (April, 1960). In Russian.

Gives a simple derivation of Plachek's formulae (1935) which give the dependence of the Raman line intensities on the angle of observation and the degree of depolarization. Reports measurements of the angular dependences of the Raman line intensities of CCl_4, benzene and chloroform, which agree satisfactorily with Plachek's theory. A.Tybulewicz

535.33 : 539.19

19413 THE INTENSITIES OF RAMAN LINES. I.I.Kondilenko, P.A.Korotkov and V.L.Strizhevskii.

Optika i Spektrosk., Vol. 9, No. 1, 26-33 (July, 1960). In Russian.

Quantum electrodynamics is used to obtain expressions for the Raman line intensities, differing from the well-known Plachek's formulae (1935). The intensity in a given direction depends on the incident-light intensity, on frequencies of the incident and scattered light and on other parameters. To compare the new expressions with experiment the intensities of two Raman lines of liquid benzene (992 and 3062 cm^{-1}) were investigated as a function of the incident-light frequency; the experimental results agreed better with the new expressions than with Plachek's formulae. The effect of a solvent on the Raman line intensities is discussed.

A.Tybulewicz

535.33 : 535.41

19414 SPECTRAL LINE BROADENING MEASURED BY SHEARING INTERFEROMETRIC METHODS.

J.Ericsson and L.P.(Johansson) Sjöfall.

Optica Acta, Vol. 7, No. 2, 105-12 (April, 1960).

A shearing interference method for determining spectral line widths and shapes from the visibility curve of two-beam interferences as a function of the path difference between the interfering wavefronts is described. The visibility is the Fourier transform of the intensity curve of the spectral line. In each measurement a limited number of points of the visibility curve is determined, but this is sufficient to give a rough estimation of the whole curve if the points are properly chosen. The image is preferably registered by a photographic plate which is then measured in a microdensitometer. Hence light sources of very low intensities can be investigated. Two slightly different shearing interferometers have been used, one with a Savart plate combined with an entrance slit and the other with a Woolaston-type compensating prism for large apertures. In the latter case, no entrance slit is necessary and combinations with a wide band monochromator can be made without any serious loss of intensity. The green line from mercury-spectral lamps has been examined, and measurements on a high pressure lamp are reported.

535.33

19415 CONSTRUCTION AND PERFORMANCE OF A HIGH RESOLUTION GRATING SPECTROMETER.

S.P.S.Porto, A.Szulc, J.R.P.Neto and W.O.N Guimarães.

An. Acad. Brasil Cienc., Vol. 32, No. 1, 25-30 (1960).

An f/20 Eberg-type monochromator with two spherical mirrors was built. The slits are of the deformable steel-ring type and photomultipliers or PbS photoconductive cells are used as detectors. A light-chopping frequency of 22 c/s is used and a suitable narrow-pass band amplifier was designed. The errors associated with the rotation mechanism of the grating are smaller than 0.02° and the final resolving power obtained exceeds 50 000.

535.33

19416 ABSORPTIVITY RECORDER.
D.D.Tunnicliff and R.C.Hawes.
J. Opt.Soc. Amer., Vol. 50, No. 11, 1039-42 (Nov., 1960).

An accessory has been designed for the Cary recording spectrophotometers which records on a 3- or a 5-decade semilog chart the absorptivity of the sample while the spectrophotometer is recording the absorbance of a dilution of the sample. The product of sample concentration and cell length for each dilution is set into a Veeder counter coupled to a simple analogue computer that converts the observed absorbance to absorptivity. One or more curve segments of absorptivity versus wavelength are obtained for each dilution of the sample. The composite of all segments obtained from a series of dilutions yields a continuous spectrum over the desired wavelength interval. This accessory greatly facilitates the interpretation of an unknown spectrum of the intercomparison of a series of related spectra. It can also be used for obtaining reference spectra of pure compounds.

535.33

19417 NEW SPECTROSCOPIC SYSTEMS GIVING HIGH LUMINOSITY. A.Girard.
Optica Acta. Vol. 7, No. 1, 81-97 (Jan., 1960). In French.

The three systems described can give, in the absence of large photon noise, a spectral analysis with much greater luminosity than is possible in slit spectrographs. The first is a polarizing interferometer adapted to spectroscopy using the Fourier transform method. It gives great luminosity, is convenient in use, but has not a very high resolving power. The other two systems give the spectrum directly, without calculations and the general arrangement of slit spectrographs is used. In both cases the entrance and exit slits are replaced by systems, imaged one on the other by the system, consisting of multiple arrays of slits, of unequal widths and arranged at unequal spacings. The particular spectral element which gives an image of the entrance array superposed on the exit array is thus filtered, due to a property which makes it identifiable. One system (compensator spectrometer) gives a selective modulation of this spectral element. In the other system (spectrometer with screens) the signal corresponding to this element is given by the difference of the transmitted and reflected flux at the exit array. The principles of these three systems have been verified experimentally.

535.33

19418 A MONOCHROMATOR FOR THE VACUUM ULTRA-VIOLET. L.D.Isaacs, W.C.Price and R.G.Ridley.
Optica Acta, Vol. 7, No. 3, 263-70 (July, 1960).

The design and construction of a vacuum ultraviolet monochromator suitable for photoelectric spectrometry and photoionization studies at short wavelengths is described. It incorporates a device for moving the exit slit along the beam to keep the spectrum in focus as the grating is rotated. The tank is divided transversely into two sections for permitting easy adjustment or interchange of gratings without disturbing the driving mechanism. An elaborate system of baffles is used to reduce scattered radiation to a very low value. A variety of attachments fit on to the exit slit for the examination of solid, liquid or gaseous samples and for photoelectric or photo-ionization measurements.

535.33 : 522.5

FABRY—PEROT MONOCHROMATOR. See Abstr. 18584

535.33

19419 SIMPLE METHOD FOR STOPPING A RADIATION CHOPPER IN A PREFERRED POSITION. M.F.Kimmitt.
J. sci. Instrum., Vol. 37, No. 11, 439 (Nov., 1960).

The chopper in an infrared vacuum spectrometer was unbalanced using two ball bearings moving in a metal tube.

W.Steckelmacher

535.33 : 533.5

FLAP-VALVE FOR LONG NARROW APERTURES IN VACUUM SPECTROGRAPH. See Abstr. 19235

535.33 : 522.5

INSTRUMENT PROFILE AND RESOLVING POWER OF THE 9 METRE SPECTROGRAPH. See Abstr. 18587

535

19420 SPECTRAL INVESTIGATIONS IN THE REGION NEA 1 mm WAVELENGTH. V. A COMPARATIVE MEASU FOR OPTICO-SPECTROSCOPIC SYSTEMS. W.Eckhardt.
Z. Phys., Vol. 159, No. 4, 405-10 (1960). In German.

For Pt IV, see Abstr. 4326 of 1956. In relation to the conditi pertinent to the 1 mm wavelength region, an invariant of optical spectrometers, the spectroscopic formation flux rate, is derived from the characteristic parameters of the obtainable spectra. Th invariant is a comparative measure for the performance of spect scopic systems differing in design and mode of operation. A tran formation formula is derived for the comparison of spectra recorded at different wavelengths.

535

19421 SPECTRAL INVESTIGATIONS IN THE REGION 1 mm WAVELENGTH. VI. THE CONSTRUCTION OF A PULSE MASS RADIATOR AND ITS PROPERTIES AS A SPECTRO SCOPIC RADIATION SOURCE. W.Eckhardt.
Z. Phys., Vol. 160, No. 2, 121-44 (1960). In German.

Based on the mass-oscillator principle, a pulsed radiation source has been developed which emits a continuous spectrum at the long wavelength end of the infrared region. In order to fully utilize the short radiation pulses, this generator is used in conjun tion with a crystal rectifier, responding to the instantaneous value of the radiation power, and a pulse lock-in demodulator. At wavelengths >~ 1.5 mm this combination — compared with the high-pressure Hg arc — yields an increase of the spectroscopic information flux rate of the recorded spectra by more than an order of magnitude. The limited reproducibility of the basic mass-oscilla spectra necessitates the alternating recording of the two spectra which are to be compared.

PHYSICAL OPTICS

(Luminescence is included under Solid-State Physics, Liquid State, or Gaseous State)

535.

19422 DESCRIPTION OF AN EXPERIMENTAL ARRANGEME ALLOWING THE STUDY, UNDER VACUUM, OF THE OPTICAL PROPERTIES OF THIN METALLIC FILMS.
J.P.David and J.Tortosa.
J. Phys. Radium, Vol. 20, No. 6, 651-3 (June, 1959). In French.

The arrangement described enables the reflection and transmission factors and the phase change on reflection to be determine for any chosen wavelength. E.A.Musse

535.3

19423 STRUCTURE AND REFLECTING POWER OF SILICON FILMS OBTAINED BY VACUUM EVAPORATION.
S.Robin-Kandare, M.H.Damany and L.Tertian.
J. Phys. Radium, Vol. 20, No. 4, 504-6 (April, 1959). In French.

The silicon was evaporated by electron beam bombardment. Heating the support to 600-700°C under vacuum produced crystalline films but if the films were first exposed to air before the vacuum heating they remained amorphous. The crystalline films had a higher u.v. reflectivity than amorphous ones; reflectivity curves for the range 1000-3000 A are given.

E.A.Musse

535.3

19424 OPTICAL PROPERTIES OF METAL FILMS IN THE REGION OF THE ANOMALOUS SKIN EFFECT.
Van Si-fu [Wang Hsi-fu], V.P.Silin and E.P.Fetisov.
Optika i Spektrosk., Vol. 7, No. 4, 547-51 (Oct., 1959). In Russian.

Optical properties of metal films are considered in the case when the losses due to diffuse scattering of electrons at the surface cannot be neglected. Formulae are given for the phase-shifts of reflected and transmitted waves, and for the reflection (R), transmission (T), and absorption ($A = 1 - R - T$) coefficients.

A.Tybulewicz

535.39

19425 NEW RECURRENT FORMULAE IN THE THEORY OF MULTILAYERED OPTICAL COATINGS. P.G.Kard.
Optika i Spektrosk., Vol. 9, No. 1, 95-100 (July, 1960). In Russian.

Reports derivation of new recurrent formulae which are essentially different from Vlasov's expressions (1946). These new formulae give the parameters $a = r/d$, $b = 1/d$, where r and d are flection and transmission coefficients of a system consisting orbing isotropic layers. In some cases the new formulae ore convenient than Vlasov's expressions. A.Tybulewicz

535.41

26 REFINEMENTS TO THE USE OF A PHOTOMULTIPLIER—MICHELSON INTERFEROMETER SYSTEM FOR AL WAVELENGTH AND SPECTRAL PROFILE MEASURES OF HIGH SENSITIVITY.

J.Terrien.

Acta, Vol. 6, No. 4, 301-7 (Oct., 1959). In French.

description is given of recent refinements in the photoelectric vation of fringes in the Michelson interferometer, with examples results obtained. A first refinement consists in the graphic ding of the current of the photomultiplier detecting the fringes period of time, at different path lengths. This is equivalent ery great increase in the time constant, so as to eliminate ations from shot noise. The precautions are described which ecessary to eliminate small systematic errors, and give sta-. A second refinement is that the mean currents are measured x orders of interference, at regular intervals of about 0.25, ed by tilting the compensating plate. The readings give six on a sinusoidal curve. A simple calculation then gives the , the visibility, and the mean luminosity, as well as the rate all variations, assumed to be linear, of these three quantities g the observations. The information available is thus completely ed, and the sensitivity allows an accuracy of about one-andth of a fringe at an order of interference of the order of 10^6, g some 10^{-9} in the comparison of two wavelengths, with photo-ric currents of 10^3 to 10^4 electrons per second.

535.41

9427 HALF-SHADE SETTING SYSTEM FOR THE MICHELSON INTERFEROMETER.

P.Hariharan and D.Sen.

t. Soc. Amer., Vol. 50, No. 10, 1026-7 (Oct., 1960).

The adjustment for the familiar half-shade method of using the elson interferometer is rendered much easier by a double pass-sing a corner cube replacing one mirror to reverse the beams back gh the system. An alternative double pass system using a cting mirror and lens is also treated. A λ/4 layer of MgF is as the half-shadow strip. Settings can be repeated to within 2 λ. S.Tolansky

535.41

9428 VISIBILITY OF FRINGES IN A TWYMAN—GREEN INTERFEROMETER.

S.C.Som.

ssoc. Appl. Physicists, Vol. 4, No. 3, 101-7 (Sept., 1957).

An application is discussed of the concept of partial coherence e case of the Twyman—Green interferometer set up for the ing of lens systems and telescopes. The maximum size of source btain a given visibility of the fringes has been obtained as a tion of the instrument parameters. No fringe distortion is seen e present, subject to a small approximation normally satisfied ractice.

535.41

19429 ON TRANSMISSION AND REFLECTION ECHELONS.

S.K.Joshi, N.K.Sanyal and S.S.Mitra.

ik, Vol. 17, No. 6, 330-4 (June, 1960).

Two new methods of using Michelson's and Williams' echelons mixed-type interferometers, resulting in an increase in resolving ver, are discussed. The effect of absorption on the intensity tern is also considered. The different modes of use are com-ed.

535.41

19430 AN INTERFEROMETRIC METHOD FOR PRODUCING VARIABLE-FREQUENCY SINE-WAVE PATTERN.

V.R.K.Murty.

Opt. Soc. Amer., Vol. 50, No. 11, 1084-8 (Nov., 1960).

Three modifications of the Michelson interferometer are scribed to give straight fringes with linearly variable frequency. e modifications are done in such a manner that the order of erference is very low and hence fringes of high contrast are tained. A brief theory of these modified versions of the Michelson erferometer is presented and conditions are derived for the oduction of fringes of best contrast.

535.41

19431 MEASUREMENT OF THE OPTICAL THICKNESS OF ABSORBING SPECIMENS WITH THE THREE-BEAM INTERFEROMETER.

P.Hariharan and D.Sen.

J. sci. Instrum., Vol. 37, No. 11, 417-19 (Nov., 1960).

A simple modification of the three-beam interferometer is described which permits measurements of the optical thickness of absorbing specimens with a high degree of accuracy.

535.41

19432 INTERFEROMETRIC MEASUREMENTS OF WAVELENGTHS. VI. MEASUREMENTS IN THE REGION 3940-4450 A.

S.Nichols and S.V.M.Clube.

Monthly Not. Roy. Astron. Soc., Vol. 118, No. 5, 496-503 (1958).

For Pt. IV-V, see Abstr. 1004-5 of 1959.

535.41

19433 NOTE ON "FRACTIONAL ORDER SLIDE RULE FOR INTERFEROMETRIC LENGTH MEASUREMENT".

K.H.Hart.

Rev. sci. Instrum., Vol. 31, No. 10, 1166 (Oct., 1960).

See Abstr. 6943 of 1960 for the original article.

535.41 : 535.33

SPECTRAL LINE BROADENING MEASURED BY SHEARING INTERFEROMETRIC METHODS.

See Abstr. 19414

535.41

19434 NEW TABLES OF THE INTERFERENCE COLOR.

H.Kubota.

Proc. Japan Acad., Vol. 36, No. 7, 418-23 (July, 1960).

The trichromatic coefficients for the colour produced by a doubly refracting crystal between Nicol prisms are calculated for various amounts of double refraction, for both illuminants A and C, and the colours plotted on the C.I.E. diagram. E.A.Mussett

535.41

19435 A PHOTOELECTRIC INTERFEROMETRIC TECHNIQUE FOR THE DETERMINATION OF PLANE STATES OF STRAIN.

H.Favre, W.Schumann and E.Stromer.

Schweiz. Bauztg, Vol. 78, No. 36, 577-84 (Sept. 8, 1960). In German.

The phase difference produced in an optical model by an application of strain is studied by an interferometric method. The method is that of Fabry in which the model itself becomes the interferometer. The theory of the method is developed in detail. Calculations are made of the intensity distribution in this system. The optical set-up is described, photoelectric methods being employed for the intensity measurements. The method has high sensitivity and the technique is described in detail. S.Tolansky

535.41

19436 APPLICATIONS OF THE INTERFERENCE STRIOSCOPE TO METROLOGY.

M.Philbert.

Rev. Opt., Vol. 37, No. 12, 598-608 (Dec., 1958). In French.

A simple apparatus is described, using interference between two beams formed by binefringence. Its application in wind tunnel work is given in detail and some results are shown. Other uses are the testing of the figure of optical surfaces and the detection of veins in optical materials. R.W.Fish

535.42 : 534.2

19437 ON THE THEORY OF THE DIFFRACTION OF LIGHT BY TWO PARALLEL ULTRASONIC WAVES, ONE BEING THE N-th HARMONIC OF THE OTHER.

R.Mertens.

Z. Phys., Vol. 160, No. 3, 291-6 (1960).

Assuming the validity of Raman and Nath's (1935) preliminary theory, the amplitudes of the light diffracted by two parallel ultrasonic waves consisting of a fundamental tone and its nth harmonic are compared in the following cases: (1) the sound waves are superposed; (2) the side waves are side by side. The diffraction patterns are approximately the same if the condition

$$\frac{\pi n L}{\lambda^*} \sin|\theta_s| \ll 1$$

is fulfilled, where $\sin\theta_s = -s\lambda/\mu_0\lambda^*$ (s being an integer); λ is the wavelength of the incident light in vacuum, λ^* is the wavelength of the fundamental of the sound waves, μ_0 is the refractive index of the medium and L the width of the sound field. The good agreement between the recent experiments of Murty and Rao (Abstr. 2254 of 1960) in the arrangement of case (2) and theoretical results calculated in case (1) is thus justified. The theoretical confirmation of older experiments of Pande, Pancholy and Parthasarathy is thereby established at the same time.

535.42 : 534.26

DISSIMILARITY OF DIFFRACTION OF SOUND AND LIGHT.

See Abstr. 19297

535.42

19438 DETERMINATION OF THE PHASE IN FRAUNHOFER DIFFRACTION PATTERNS FROM UNIDIMENSIONAL OBJECTS.

H.Boersch, J.Geiger and H.Raith.

Z. Phys., Vol. 160, No. 1, 66-73 (1960). In German.

A comparison pattern from a very narrow slit was superposed on the pattern to be investigated; the two being coherent, interference fringes were formed from which the phase relative to the comparison pattern could be deduced. Qualitative agreement with theory was found for phase and amplitude objects. W.T.Welford

535.42

19439 ESTIMATION OF THE REQUIRED MEASURING ACCURACY AND SIGNAL—NOISE RATIO WHEN THE FIELD OF VIEW IS REDUCED IN ORDER TO IMPROVE RESOLUTION.

H.Wolter.

Physica, Vol. 26, No. 1, 75-8 (Jan., 1960). In German.

If the object field is restricted to include only E separate elements (e.g. grating bars) and a resolution V times that given by the Abbe formula is required then there is an upper bound s to the allowable noise. An approximate formula connecting E, V and s is obtained. W.T.Welford

535.42

19440 SPHERICAL ZONE-PLATE DIFFRACTION GRATING.

M.V.R K.Murty.

J. Opt. Soc. Amer., Vol. 50, No. 9, 923 (Sept., 1960).

A zone plate on a plane surface has focusing properties and by a correct choice of grating spacing may be made free from spherical aberration for a given pair of conjugates. A zone plate on a spherical surface can in addition be made aplanatic, i.e. satisfy the sine condition, as well as be free from spherical aberration. The conditions for the zone plate spacing are derived for a reflecting zone plate. R.W.Fish

535.42

19441 USE OF REFLECTION ECHELON WITH INCREASED RESOLVING POWER.

S.S.Mitra.

J. Opt. Soc. Amer., Vol. 50, No. 10, 1028-9 (Oct., 1960).

The resolving power obtained from a reflection echelon is calculated for the case of reflection taking place within the material, i.e. instead of illuminating the reflectors from the air side, illumination is considered in the reverse sense, from the glass side. The effect of absorption in the glass is taken into account. S.Tolansky

535.42

19442 CONTRIBUTION TO THE STUDY OF REFLECTION OF THE FAR INFRARED BY THE ECHELETTE GRATING.

A.Hadni, C.Janot and E.Decamps.

J. Phys. Radium, Vol. 20, No. 7, 705-11 (July, 1959). In French.

The diffraction problem of the echelette grating is considered by an approximate method for both positions of the principal section plane of the grating relative to the incidence plane; parallel and perpendicular. It is explained why the zero order is larger in the second case and an accurate use of echelette gratings as zero order filters in the far infrared is derived. The theory is verified by experiments with different gratings.

535.42

19443 NONPERIODIC GRATING ERRORS IN ECHELETTE AND PLANE GRATINGS.

H.Böttcher and M.Schubert.

Optik, Vol. 17, No. 4, 192 202 (April, 1960). In German.

The influence of nonperiodic grating errors on the filter and dispersion characteristics is investigated. General relations are established for the dependence of the mean intensity on relative errors in the grating constant. Simple formulae for use in practice are deduced from these relations and their application is discussed.

53

19444 A SELF-SUPPORTING METAL FRESNEL ZONE-PL TO FOCUS EXTREME ULTRA-VIOLET AND SOFT X-RAYS.

A.V.Baez.

Nature (London), Vol. 186, 958 (June 18, 1960).

A Fresnel zone-plate has been constructed consisting of 19 metal zones held together by thin radial struts so that the transparent zones are empty. The central circle has a diameter of 0.04 cm, the outer circle one of 0.26 cm, the thickness being 10μ The narrowest gold band is 20μ wide. Tests with visible light an u.v. down to 2537 A were very successful and suggest the zone-pl should focus well at wavelengths below 100 A. Possible future us of a zone-plate X-ray telescope in an orbiting satellite is indicat J.I

53

19445 MIE THEORY OF LIGHT SCATTERING. LIMITATIO ON ACCURACY OF APPROXIMATE METHODS OF COMPUTATION.

R.D.Murley.

J. phys. Chem., Vol. 64, No. 1, 161-2 (Jan., 1960).

An approximate method due to Penndorf (Abstr. 8006 of 195 for calculating the light scattering from colloidal spheres is com pared with the results obtained using the Mie theory. There is considerable discrepancy and it appears that Penndorf's method must be limited to systems for which the refractive index of the particles relative to the surrounding medium is ≤ 1.6.

H.G.Jerr

535

19446 DETERMINATION OF THE PARTICLE SIZE FROM SCATTERING OF LIGHT. II. DETERMINATION OF DIMENSIONS OF POLYCHLOROPRENE LATEX GLOBULES, USING OPTICAL AND ELECTRON-MICROSCOPIC METHODS.

I.Ya.Slonim, N.M.Fodiman and Z.M.Ustinova.

Optika i Spektrosk., Vol. 8, No. 2, 243-6 (Feb., 1960). In Russian

In Pt I (Abstr. 12496 of 1960) Slonim deduced formulae for calculation of particle radii from the results of light scattering in monodisperse system (all particles of the same size). These for lae were now applied to a polydisperse system (particles of differ sizes) of polychloroprene latex globules and a certain effective mean value of the radius was obtained. This mean radius was confirmed by electron-microscopic measurements. A.Tybulewi

535.4

19447 SCATTERING OF LIGHT BY DIELECTRIC ELLIPSOIDS OF SIZE COMPARABLE WITH THE WAVELENGTH. I. A GENERAL EXPRESSION FOR THE SCATTERING INDICATRIX OF AN ELLIPSOIDAL PARTICLE.

A.V.Shatilov.

Optika i Spektrosk., Vol. 9, No. 1, 86-91 (July, 1960). In Russian.

Discusses diffraction of an electromagnetic wave on an anisotropic non-absorbing ellipsoid using the first approximation. Expressions are obtained for the scattering parameters of particl with low refractive index. The dependence of the scattering indicatrix on the dimensions, eccentricity and orientation of scatterin ellipsoids is discussed. A.Tybulewicz

535.43 : 523.

19448 THE SCATTERING OF LIGHT IN A MEDIUM WITH A MOVING BOUNDARY.

S.A.Kaplan, I.A.Klimishin and V.N.Sivers.

Astron. Zh., Vol. 37, No. 1, 9-15 (1960). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, 7-12 (July-Aug., 1960).

The calculation of the probability of escape of a quantum from a medium after scattering is reduced to the solution of 3 integral equations, covering the 2 cases: (1) the quantum is in the absorbed state for most of the time; (2) the quantum is in the free state for most of the time. The solution of these equations is given.

535.43

19449 ASYMPTOTIC BEHAVIOUR OF THE FUNCTION REPRESENTING THE LUMINOUS INTENSITY SCATTERED BY SOLUTIONS OF ANISOTROPIC RODS.

P.Horn and H.Benoît.

C.R. Acad. Sci. (Paris), Vol. 251, No. 2, 222-4 (July 11, 1960). In French.

The influence of anisotropy is evaluated. It is shown that it is necessary to take this anisotropy into account when determining the mass per unit length of the particles. H.G.Jerrar

535.43 : 523.87

LIGHT SCATTERING IN HOMOGENEOUS SPHERICAL SPHERE
I CENTRAL ENERGY SOURCE. See Abstr. 18842

535.43

450 NEW MEASUREMENTS OF THE DEPOLARIZATION FACTOR [ρ] OF RAYLEIGH SCATTERING IN VAPOURS.

ssoulier.
Acad. Sci. (Paris), Vol. 251, No. 3, 358-60 (July 18, 1960).
ench.

Measurements are made photographically and values of ρ are gene- less than earlier values by the amounts indicated: benzene (10%), one (35%), butanol (130%), propanol (200%); measurements on agree with earlier ones. G.F.Lothian

535.5

451 DISPERSION OF ELECTROMAGNETIC WAVES IN CRYSTALS. V.M.Agranovich.

eksper. teor. Fiz., Vol. 37, No. 2(8), 430-41 (Aug., 1959).
ssian. English translation in: Soviet Physics—JETP (New), Vol. 37(10), No. 2, 307-13 (Feb., 1960).

A microscopic quantum theory of dispersion of electromagnetic es in molecular crystals is developed. An expression is derived he index of refraction due to the contribution of the excited states e electrons. Interaction between exciton states and the field is idered without the use of perturbation theory.

535.5

9452 PROPAGATION OF LIGHT IN ABSORBING MAGNETIC ACTIVE ISOTROPIC MEDIA AND CUBIC CRYSTALS.

.Bokut' and F.I.Fedorov.
ika i Spektrosk., Vol. 7, No. 4, 558-61 (Oct., 1959). In Russian.

Discusses propagation of plane electromagnetic waves in an cally isotropic medium, possessing optical absorption, optical vity and magnetic properties. It is shown that when the magnetic ms of optical activity are taken into account, circular dichroism uld occur. A.Tybulewicz

535.5

19453 MICROSCOPIC OBSERVATION OF SMALL DROPS OF WATER UNDER LATERAL ILLUMINATION.

Bricard and M.Deloncle.
n. Geophys., Vol. 15, No. 2, 272-81 (1959). In French.

Considers the images of small drops of water, such as occur fogs, seen in a microscope when the directions of illumination d observation are at right angles. The intensity and state of larization in the image are calculated and compared with photo- aphed images. The effect of condenser and objective apertures briefly discussed. R.W.Fish

535.5

19454 PHOTOELECTRIC DETERMINATION OF THE POSITION OF THE NEUTRAL LINES AND THE PHASE DIFFER- NCE OF A WEAKLY BIREFRINGENT MEDIUM.

Leray and G.Scheibling.
R. Acad. Sci. (Paris), Vol. 251, No. 3, 349-51 (July 18, 1960).
French.

An arrangement is described in which light is passed through a larizer P, the medium M, a birefringent plate L, an analyser A d then falls on a photomultiplier. The plate L rotates about an is along the light direction at a constant angular velocity ω and so odulates the light. The photomultiplier current is made up of a nstant term, a sinusoidal component of frequency 4ω and an ternating signal of frequency 2ω. Measurements are made by otating P and A, or A only, until the signal of frequency 2ω is zero. he settings of P and A enable the retardation and the position of the eutral lines to be found. H.G.Jerrard

535.5

19455 NOTE ON THE THEORY OF OPTICAL ACTIVITY. R.A.Houstoun.

Optica Acta, Vol. 6, No. 3, 216-21 (July, 1959).

It has been generally assumed that no simple explanation of natural optical activity can be given from the standpoint of classical dispersion theory. The present paper shows that two possibilities have been overlooked. Either one class of electrons may be spinning, in which case they set themselves with their axes parallel to the direction of propagation of the light wave and are acted on by the magnetic as well as by the electric intensity of the light wave. Or there may be a product term in the expression for the potential energy of the electron.

535.51

19456 ROTATION OF THE PLANE OF POLARIZATION OF LIGHT AND THE SYMMETRY OF CRYSTALS.

I.S.Zheludev and A.S.Sonin.
Kristallografiya, Vol. 4, No. 3, 425-9 (May-June, 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 3, 399-403 (March, 1960).

A study of the changes in symmetry of crystals giving rise to a change of specific rotation of the plane of polarization of light. Results of an analysis are given for any of the 32 classes. If the change in symmetry of a crystal on a phase transition is regular and gives rise only to a change in rotation of the plane of polarization of light, then the calculated changes are given in tabular form. S.Tolansky

535.51

19457 PHOTO-ELECTRIC METHOD OF MEASURING THE ANGLE OF ROTATION OF THE PLANE OF POLARIZATION OF LIGHT WAVES. R.Y.Keimakh and V.I.Kudryavtsev.

Priborostroenie, 1959, No. 11. In Russian. English translation in: Instrum. Constr., 1959, No. 11, 12-16 (Nov.).

The method described forms the basis of an automatic recording or control system. A Faraday effect modulator is placed between the polarizer and analyser of the polarizing system and is fed by an a.c. current. A photocell is then used to drive a 2 phase motor coupled to the polarizer, which seeks the zero phase difference position. Typical examples of polarimeters, saccharimeters etc. using the method are given. R.W.Fish

535.51

19458 THE RELATION BETWEEN INTERSTELLAR EXTINCTION AND POLARIZATION. R.Wilson.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 1, 51-63 (1960).

An approximate solution of the problem of scattering by a long dielectric cylinder, with axis inclined at an arbitrary angle to the line of sight, is given for the limiting case of refractive index $m \to 1$. Using this, extinction curves are computed for a fixed sample of particles with different angular frequency distributions. These distributions are chosen to give maximum and zero polarization according to the different theories of alignment. The curves differ substantially and it is predicted that the colour excess per unit mass and the ratio of colour excesses $E_{(U-B)}/E_{(B-V)}$ are both functions of the polarizability $p/E_{(B-V)}$. Both these predictions are tested against existing observations, with a positive result in favour of the distribution predicted by the Davis-Greenstein alignment mechanism. An important corollary of the investigation is that the ratio R of total to selective extinction is also a function of the polarizability, R increasing by about 60% as the polarizability increases from zero to its maximum value.

535.51 : 523.6

A STUDY OF THE MONOCHROMATIC POLARIZATION OF COMET AREND—ROLAND (1956 h). See Abstr. 18729

535.52

19459 INSTRUMENT FOR THE MEASUREMENT OF SPECULAR REFLECTIVITY OF BRIGHT METAL SURFACES.

B.A.Scott.
J. sci. Instrum., Vol. 37, No. 11, 435-8 (Nov., 1960).

A simple modification of the gloss head for painted surfaces, described in Defence Specification DEF/1053 (Method 11), enables it to be used for the measurement of the surface quality of bright anodized aluminium in terms of specular reflectivity. The instrument has a high sensitivity, and readily discriminates between surfaces of differing appearance. Good reproducibility between two instruments after modification, and satisfactory correlation with visual assessments of surface quality, have been obtained. The instrument could be used for the evaluation of bright finishes on other metals, but is not suitable for matt or highly diffusing surfaces.

535.56

19460 A MECHANICAL APPARATUS ENABLING THE MEASUREMENT BY COMPENSATION OF A KERR CONSTANT. M.L.Allais.

J. Phys. Radium, Vol. 19, Suppl. No. 12, 176A-180A (Dec., 1958).
In French.

When it is necessary to measure an unknown Kerr constant by compensation method, one must be able rigorously to align the axes of the two cells, along the direction of the light rays. On a steel plate, gliding on an optical bench, is set a Plexiglas plate, which may be fixed in position for a middle adjustment (moving parts: brass and duralumin). In the groves of this plate, the supports of the cells may slide in the direction of the optical bench. These supports, entirely in Plexiglas, consist essentially of two rings which hold the cell on each side. The rings can be adjusted longitudinally by sliding on 4 small horizontal columns, fitted in a central core, to which is connected a cylindrical base supported by the Plexiglas plate. The movements of adjustment of these elements correspond to the different degrees of freedom. Detailed analysis of all the possibilities of movement is given.

COLORIMETRY . PHOTOGRAPHY

535.65

19461 GRAPHIC TEST FOR LINEAR FIT TO KUBELKA–MUNK ANALYSIS. R.S.Teague.
J. Opt. Soc. Amer., Vol. 50, No. 10, 1027-8 (Oct., 1960).

In a mixture of two colorants, the validity of the Kubelka–Munk relationship can be tested by plotting $\log(K/S)$ against

$$\log\{f_b/(1-f_b)\}$$

where K and S are respectively the absorption and scattering coefficients of the mixture and f_b is the fraction of nonscattering black colorant. J.W.T.Walsh

535.65

19462 ON THE COLOUR SCALE FOR THE SEA WATER. O. Matumura.
Mem. Fac. Sci. Kyusyu Univ. B, Vol. 3, No. 1, 1-2 (March, 1960).

The colour-theoretical examination of Forel's Colour Scale has been carried out, and some improvements are attempted.

77 : 537.52

19463 REPORT ON HIGH-SPEED PHOTOGRAPHY. A.Folkierski.
Nuclear Instrum. and Methods, Vol. 4, No. 5, 346-51 (June, 1959).

The application of Kerr cells, image convertors, rotating mirror cameras and drum cameras to the photography of fast electrical discharges is critically discussed. The performance of representative examples of each of these techniques is given quantitatively.

77

19464 THE PHOTOGRAPHIC PROCESS AS A DIATOMIC REACTION. C.Candler.
Austral. J. Phys., Vol. 13, No. 2a, 419-36 (July, 1960).

Solid State Physics Conference (see Abstr. 17864 of 1960). If sensitive areas exist in unexposed crystals, the number of grains which develop on exposure is given by the Poisson law, and this conflicts with experiment, but, if a developments centre is formed in a diatomic reaction triggered by P trapped electrons, the fraction n of the grains capable of development after an exposure E is $n/(1-n) = (sE)^P$, where s is the reaction cross-section. Examination of the papers of earlier workers shows that $\log\{n/(1-n)\}$ is linear in log E for any one grain size, so theory is confirmed. The photon number P increases with the size of crystals, but discontinuously. Nonintegral values of P cannot be attributed to a mixture of grains each with P integral, but are inherent in the constitution of a single grain. The reaction cross-section s can be accurately calculated, when the exposure is measured in absolute units, for the theory of dimensions requires that E be expressed in photons per unit area. In two emulsions s is proportional to the volume of the crystal.

77

19465 AN ELECTRON SPIN RESONANCE INVESTIGATION OF PHOTOGRAPHIC PROCESSES IN CRYSTALS OF AgCl CONTAINING TRACES OF CuCl.
I.S.Ciccarello, M.B.Palma-Vittorelli and M.U.Palma.
Phil. Mag. (Eighth Ser.), Vol. 5, 723-7 (July, 1960).

An electron spin resonance spectrum, due to the formation of cupric ions during illumination, was observed in crystals of silver chloride containing 0.1 mol % of cuprous chloride, which were quenched to −183°C immediately following irradiation. The spectrum fades rapidly if the crystals are kept at any temperature above −140°C after the end of illumination. An interpretation of this behaviour is given which is based upon the Mitchell theory of the photochemical process in crystals of silver halides.

19466 THE SENSITIVITY DISTRIBUTION IN PHOTOGRAPHI EMULSIONS. G.Haase.
Naturwissenschaften, Vol. 47, No. 14, 320 (1960). In German.

The sensitivity distribution among the grains of an emulsion i a function of particle size and of the number of quanta required to make a given grain developable. The distribution is relevant to th determination of blackening curves, but hitherto has not been measured independently. It is now shown to be a logarithmic normal distribution, as is the particle size distribution, for two highly sensitive emulsions, and the constants in the equations are given. S.T.Henders

19467 PHOTOGRAPHIC SENSITIVITY OF IMAGE INTENSIFIERS WITH THIN END WINDOWS. L.Mandel.
Optica Acta, Vol. 6, No. 4, 354-66 (Oct., 1959).

Density-exposure curves are calculated on the basis of the statistical "two or more quanta" theory of photographic exposure (Abstr. 255, 4560 of 1939, 798 of 1941, 2486 of 1945, 3661 of 1950) for an emulsion exposed in close contact with the thin end window o an image intensifier. The curves are compared with those obtained for direct exposure without intensification. It is shown that the effective photographic gain defined in this way exceeds the light gai of the image tube, as measured photoelectrically, even for identical spectral distributions at the input and output. The ratio of photographic gain to light gain may become large at low light levels and high intensification, particularly for cascade intensifiers. There are two reasons for this: the reciprocity failure of the photographi process and the strongly clustered spatial distribution of the photon emitted from the image tube. The significance of the latter effect depends on the thickness of the end window and some density-exposure curves are derived for different thicknesses.

77 : 535.3

PHOTOGRAPHIC IMAGERY: GEOMETRICAL AND WAVE OPTICS. See Abstr. 19369

77 : 535.31

SPECTRAL ANALYSIS OF PHOTOGRAPHIC IMAGES. See Abstr. 19370

77 : 539.1.0

PARTICLE PHOTOGRAPHY. See Abstr. 17169

77 : 539.1.07

PHOTOGRAPHIC RECORDING METHODS IN NUCLEAR PULSE SPECTROMETRY. See Abstr. 17182

77 : 532.

PHOTOGRAPHING SHOCK WAVES IN LIQUIDS. See Abstr. 19127

HEAT . RADIATION

536.2

19468 MEASUREMENT OF THERMAL DIFFUSIVITY OF SEMICONDUCTORS BY ÅNGSTRÖM'S METHOD.
A.Green and L.E.J.Cowles.
J. sci. Instrum., Vol. 37, No. 9, 349-51 (Sept., 1960).

An apparatus for the accurate determination of the thermal diffusivity of semiconductors, which utilizes the thermoelectric properties of such materials, is described. In its present form, the apparatus can be used between room temperature and 180°C. The application of the method is illustrated by an experiment using a single-crystal specimen of bismuth telluride.

536.2

19469 DETERMINATION OF THERMAL DIFFUSIVITY BY A THERMOGRAPHIC METHOD AND ITS APPLICATION IN PHYSICO-CHEMICAL ANALYSIS. L.G.Berg and E.E.Sidorova.

Inst. Politeh. Iasi, Vol. 5(IX), No. 3-4, 95-102 (1959). ıssian.

he thermographic method of determining thermal diffusivity /cρ (λ = thermal conductivity, c = specific heat, ρ = density) lts and their alloys consists in measuring the temperature rence between the centre and surface of a spherical specimen. isotherms of thermal diffusivity were similar to the curves of ın in the case of binary systems KNO_3—$Cd(NO_3)_2$ and $_3$—$NaNO_3$. F.Lachman

536.2

19470 EXPONENTIAL TRANSFER AND DIFFUSION.
W.Rabinovitch.

ad. J Phys., Vol. 38, No. 11, 1406-27 (Nov., 1960).

The one-dimensional heat equation is solved for exponentially ıying rate of increment and decrement of temperature at the ace of a semi-infinite medium. The diffusion equation is solved exponentially decaying rate of transfer from a source to a ısion medium. The two types of sources are: mass initially located at a point, and (b) distributed at interfaces within a porous tangular parallelepiped or sphere. Solutions for subsequent contration distribution are stated, and compared with the well-known es of instantaneous transfer. Numerical evaluation is afforded he probability integral of complex argument. The treatment is licable to cases of first-order irreversible chemical reaction simultaneous diffusion of reaction products.

536.2

19471 THE METHOD OF EIGENFUNCTIONS IN THE PROBLEMS OF TRANSMISSION OF HEAT IN A ANSIENT REGIME.
B.F.de Veubeke.

l. Soc. Roy. Sci. Liege, Vol. 29, No. 7-8, 173-95 (July-Aug., 1960). French.

This is analogous to the method of normal modes of vibrations continuous media. Formal solutions are given for four different es of source of arbitrary time-dependent behaviour. In the case parallel line sources equally spaced in an infinite plate, a culation scheme is briefly described; flow rates as functions of ıe and temperature profiles at different sections are tabulated. P.Gray

536.2

19472 LAMINATED CIRCULAR CYLINDER IN A FIELD OF PERIODIC TEMPERATURE VARIATIONS.
Vodička.

angew. Math. Phys., Vol. 7, No. 5, 422-7 (Sept. 25, 1956). In rman.

Treats, from a general viewpoint, the propagation of heat waves an infinite hollow multilayer cylinder subjected to periodic riations of temperature.

536.2 : 532.5

HEAT TRANSFER AND REYNOLDS' ANALOGY IN A TURBU-ENT FLOW WITH HEAT RELEASE. See Abstr. 19070

536.2 : 532.5

NUSSELT NUMBER FOR LAMINAR FLOW IN A CYLINDRICAL UBE WITH CONSTANT WALL TEMPERATURE. See Abstr. 19061

536.2

19473 STATIONARY TEMPERATURE DISTRIBUTION IN THE WALL OF A MULTILAYERED TUBE.
V.Vodička.

. Phys. Soc. Japan, Vol. 14, No. 7, 959-65 (July, 1959). In German.

The problem is solved for the case where the boundaries are ept at given temperatures varying both in the tangential and longiudinal direction. The first part takes into account heat transfer at he surfaces of separation, and the second treats the case of a coninuous variation of temperature at each surface of separation.

536.2

19474 THE DISTRIBUTION OF TEMPERATURE ALONG ELECTRICALLY HEATED TUBES AND COILS. THEORETICAL.
K.S.Krishnan and R.Sundaram.

Proc. Roy. Soc. A, Vol. 257, 302-15 (Sept. 20, 1960).

The distribution of temperature along a filament electrically heated in vacuo was dealt with in detail in previous papers, both theoretically and experimentally. The investigations were extended to he case of a thin-walled tube. The major new factor that appeared here was the radiational transfer of energy in the core of the tube, and if one can evaluate the rate of gain in energy by a given annular ring on this account, one can readily formulate the differential equation governing the distribution of temperature along the tube. Taking ϵ to be the emissivity, and hence also the absorptivity, of the surface, and taking the fraction $(1 - \epsilon)$ of the radiation incident on the surface that is not absorbed by it to be specularly reflected, the radiational gain by the annular ring per second was found; the expression consisted of two terms, proportional to $(dT/dx)^2$ and to d^2T/dx^2 respectively, and their coefficients pointed to a temperature-dependent thermal conductivity of the core equal to $\frac{16}{3}\sigma DT^3(2 - \epsilon)/\epsilon$. It was as though the conduction was due to the thermal diffusion of the photons, and they had a mean free path equal to the diameter D of the tube, enhanced by a factor $(2 - \epsilon)/\epsilon$ as a result of the specular reflections, in the same manner in which the "coefficient of slip" of the molecules of a rarefied gas in its passage through a narrow tube is enhanced by the specular reflections of the molecules from the walls of the tube. The expression for the conductivity of the core bears a close analogy to the corresponding expression for other transport phenomena in which the mean free path of the diffusing particle is limited by the dimensions of the medium or of the enclosure, e.g. the thermal conductivity of a hot gas in a narrow tube due to the diffusion of the photons emitted by the molecules, or the thermal conductivity of a dielectric cylinder at low temperatures due to the diffusion of thermal phonons. Though the differential equation determining the temperature distribution along a tube is more complicated than that for a filament, a practically general solution can be obtained; it is found to be similar to that for the filament, except that the natural length is now considerably greater, and the longitudinal variation of the temperature considerably flatter, than in the filament. The case of a closely wound coil is very similar to that of the tube, except that the conductivity through the material of the walls is now through the wire and hence much smaller than in the tube.

536.2

19475 HEAT TRANSFER AND REYNOLDS NUMBER.
D.V.Gogate and H.S.Desai.

J. sci. industr. Res., Vol. 18B, No. 12, 531 (Dec., 1959).

The curves relating Nusselt number and friction drag coefficient to Reynolds number are obtained from experiments on steel spheres of different sizes. The existence of a critical Reynolds number in heat transfer is established, corresponding to the transition from laminar to turbulent flow in the boundary layer. R.F.S.Hearmon

536.2

19476 FRICTION AND HEAT TRANSFER OF COMPRESSIBLE FLOW INTO AN INFINITE LATTICE OF FLAT PLATES.
S.L.Soo.

Z. angew. Math. Phys., Vol. 10, No. 3, 291-310 (1959).

The two cases of a constant wall temperature and of an insulated wall are considered. The results show for low Reynolds numbers an appreciable deviation from the case of one single flat plate. R.Schnurmann

536.2 : 534.23

19477 THE EXCITATION OF THERMAL AND ACOUSTIC OSCILLATIONS DURING PERIODIC EVOLUTION OF HEAT IN THE VOLUME OF A SOLID OR GAS.
A.O.Sall'.

Zh. tekh. Fiz., Vol. 29, No. 3, 324-9 (March, 1959). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 4, No. 3, 290-4 (March, 1959).

Various solutions of the heat-conduction equation applicable to evolution of heat within the volume of a body are given. For a gas the conduction equation is solved in conjunction with an equation describing the generation of sound by thermal oscillations, the results for a typical case being exhibited as curves. It is stated that many of the results were verified experimentally. H.N.V.Temperley

536.2

19478 A LINEAR HEAT PROBLEM WITH A MOVING INTERFACE.
R.E.Gibson.

Z. angew. Math. Phys., Vol. 11, No. 3, 198-206 (May 25, 1960).

The one dimensional heat conduction problem considered consists of the determination of the functions $u_1(x,t)$ and $u_2(x,t)$ governed by

$$a_1^2 \frac{\partial^2 u_1}{\partial x^2} = \frac{\partial u_1}{\partial t}, \qquad 0 < x < s(t)$$

$$a_2^2 \frac{\partial^2 u_2}{\partial x^2} = \frac{\partial u_2}{\partial t}, \qquad s(t) < x < \infty$$

and satisfying the initial and boundary conditions

$$u_1(0,t) = g(t), \qquad t > 0$$

$$u_1[s(t),t] = u_2[s(t),t] = h(t), \qquad t > 0$$

$$u_2(x,0) = f(x)$$

where g(t), h(t) and f(x) are given. The motion of the boundary x = s(t) is specified and s(0) = 0. The solution is shown to depend on a singular Fredholm integral equation of the first kind and that this equation is capable of explicit solution when s(t) is proportional to t or $t^{1/2}$. S.Weintroub

536.2

19479 STEADY-STATE HEAT CONDUCTION IN A CIRCULAR CONE. R.Muki and E.Sternberg.

Z. angew. Math. Phys., Vol. 11, No. 4, 306-15 (July 15, 1960).

536.2 : 539.216

19480 STUDIES IN THE PROPERTIES OF HEAT INSULATING BUILDING MATERIALS. II. THE THERMAL CONDUCTIVITY OF BINARY MIXTURES WITH PARTICULAR REFERENCE TO CELLULAR CONCRETE.

M.M.Qurashi and A.K.M.Ahsanullah.

Pakistan J. sci. industr. Res., Vol. 2, No. 1, 1-9 (Jan., 1959).

For Part 1, see Pakistan J. sci. industr. Res., Vol. 1, No. 1, 53 (Jan., 1958). A formula for the thermal conductivity of a simple homogeneous mixture is derived and the formula is tested by comparison with experimental values obtained for cellular concretes. The results are applied to elucidate the behaviour of the complex cement—rice-husk—ash system. S.Weintroub

536.2 : 536.48

EVACUATED POWDER INSULATION FOR LOW TEMPERATURES. See Abstr. 19575

536.2

19481 EXPLICIT SOLUTIONS OF THE ONE-DIMENSIONAL HEAT EQUATION FOR A COMPOSITE WALL.

M.Ascher.

Math. Comput., Vol. 14, 346-53 (Oct., 1960).

A study is presented of the convergence, stability, comparative accuracy and comparative computing time of three explicit numerical solutions of the heat equation for a wall composed of two materials.

536.2

19482 THERMAL CONDUCTION IN MICA ALONG THE PLANES OF CLEAVAGE. H.J.Goldsmid and A.E.Bowley.

Nature (London), Vol. 187, 864-5 (Sept. 3, 1960).

Two methods were used to measure the thermal conductivity of phlogopite. In the first, sheets of the material were cemented together to form a block between two Cu plates and the conductivity was measured directly, and in the second, the conductivity was determined indirectly from the thermal diffusivity. The respective values obtained were 0.046 and 0.052 W cm^{-1} deg^{-1} C. S.Weintroub

536.2

19483 GASEOUS HEAT CONDUCTION AT LOW PRESSURES AND TEMPERATURES. R.J.Corruccini.

Vacuum, Vol. 7-8, 19-29 (1957-58: publ. April, 1959).

Over the large temperature differences that can exist in vacuum insulation of cryogenic devices some of the assumptions on which the formulae for free-molecule heat conduction are based are not strictly valid. The consequences of this are discussed, and some incorrect usages are pointed out. Working formulae and auxiliary data on mean free paths and accommodation coefficients at cryogenic temperatures are presented.

536.2

19484 FREE CONVECTION PAST A VERTICAL PLATE. M.Finston.

Z. angew. Math. Phys., Vol. 7, No. 6, 527-9 (Nov. 25, 1956).

536.2

19485 LOW PRANDTL-NUMBER FREE CONVECTION. J.L.Gregg and E.M.Sparrow.

Z. angew. Math. Phys., Vol. 9a, No. 4, 383-7 (1958).

Numerical solutions of the equations expressing conservation of mass, momentum and energy for laminar free convection on a isothermal vertical plate were obtained using a fast electronic c puter for Prandtl numbers of 0.003 to 0.03 (corresponding to liqu metals). The results were used to compute the heat transfer wh is shown graphically and in tabular form and which can be represented for the liquid range by Nu = 0.565 $(GrPr^2)^{1/4}$. S.Weintr

5

19486 THERMAL CONVECTION FROM A HORIZONTAL W L.J.Crane.

Z. angew. Math. Phys., Vol. 10, No. 5, 453-60 (1959).

The equations of motion for the flow generated by the diffusi of heat from a long thin horizontal wire into a uniform fluid are derived and solved. The flow both for large and small density differences is considered. R.F.S.Hear

536.2 : 53

NUMERICAL CALCULATION OF THE DIFFUSION EQUATIO WITH A CONVECTION TERM. See Abstr. 19108

53

19487 OPTICAL TRANSPARENCY AND RESISTANCE TO FLASH HEATING. W.F.Libby.

J. chem. Phys., Vol. 33, No. 5, 1588-9 (Nov., 1960).

High temperature effects at the surface of solids which comb optical transparency with low thermal conductivity, such as silica and clear plastics, are discussed and possible applications sugges G.I.W.Llewe

53

19488 GENERAL PRINCIPLES FOR THE REALIZATION OF A BLACK BODY AT HIGH TEMPERATURE.

G.F.Sitnik.

Astron. Zh., Vol. 37, No. 1, 75-8 (1960). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, 74-8 (July-Aug., 1960).

A discussion is given of a black body for use as a primary standard in the spectrophotometric calibration in absolute energy units. The various factors which influence the degree of correspo dence between the practical model and the perfect black body are discussed. The effect of a nonuniform temperature distribution on the accuracy of the model is considered. A scheme is proposed fo constructing a black body whose radiation is identical with the thermal-equilibrium radiation at the given temperature.

536

19489 A LOW TEMPERATURE STANDARD OF TOTAL RADIATION. R.E.Bedford.

Canad. J. Phys., Vol. 38, No. 10, 1256-78 (Oct., 1960).

A standard of total radiation used for the calibration of therma radiation detectors is described. The black body source is a modified cone operating over the temperature range 40°C to 150°C the detector is located in a isothermal (better than 0.01°C) environ ment. For the detectors used a decrease in sensitivity of approximately 1% during the first 24 hours was observed. This is probabl due to the slow drying of the receiver surface by the gas used to displace the air. The day-to-day reproducibility of results is abou 0.1%, and an over-all accuracy of 0.3% is claimed for radiation measurements made with the instrument. The scale of total radiation defined by four National Bureau of Standards carbon filament standards of thermal radiation probably differs from that defined here by −0.3%.

536.3

19490 STANDARD OF SPECTRAL RADIANCE FOR THE REGION OF 0.25 TO 2.6 MICRONS.

R.Stair, R.G.Johnston and E.W.Halbach.

J. Res. Nat. Bur. Stand., Vol. 64A, No. 4, 291-6 (July-Aug., 1960).

Information is given relating to the setting up of standard blac bodies for use through the temperature range from 1 400° to 2 400° and their use in the calibration of tungsten strip lamps as laboratory standards of spectral radiance for the wavelength region from 0.25 to 2.6 μ. A graphite blackbody is described and representative data are given on the spectral characteristics of the new lamp standard as compared with blackbodies at several selected temperatures.

536

19491 SIMPLE NOMOGRAM FOR RADIACTIVE INTERCHAN FACTORS. A.E.Fein.

Rev. sci. Instrum., Vol. 31, No. 9, 1008-10 (Sept., 1960).

resents a nomogram for deriving the value of F_{12}, appropriate formula $Q = F_{12}\,\sigma\,A_1(T_1^4 - T_2^4)$, from the ratio of the enclosed ınd enclosure areas, and the emissivities of the enclosed body the enclosure. R.Berman

536.3

‹92 PROPOSAL OF THE DETECTIVITY D** FOR DETECTORS LIMITED BY RADIATION NOISE.

ones.
:. Soc. Amer., Vol. 50, No. 11, 1058-9 (Nov., 1960).

ı new kind of detectivity, called D**, is proposed for cells that a detectivity that is limited by radiation noise. The detectivity akes specific account of the solid angle Ω, from which external tion can reach the responsive element. Usually, the external tion is produced by objects at room temperature. D** is also ›priate for use with detectors that are non-Lambertian for ons other than cooled radiation shields: for example, detectors are immersed in a high-index medium, or detectors that are ly associated with a lens.

536.3 : 621.376.239

›493 SYNCHRONOUS THERMAL DETECTORS.

J.P.Borel and P.Cornaz.
ıgew. Math. Phys., Vol. 11, No. 2, 89-101 (March 25, 1960). In ch.

Describes various types of phase-sensitive detector which nd, in principle, upon the heating of resistances through which simultaneously a signal current I_g and a reference current f frequency ω. If the signal current has the same frequency the reference current then the average heating is higher by cos φ than when the signal and reference current have different uencies. The temperature difference is measured in a bridge ıit of thermal elements, metal resistances or thermistors. special advantages of this detector are: (1) simplicity; obustness; (3) small dimensions; (4) functional reliability; ong life; and (6) inherent time-constant from 0.2 sec to 1.0 sec ill. In the case of types with metal resistances, the working t is such that the output voltage is independent of the magnitude e reference current I_r.

536.3

9494 ON THE POSSIBILITY OF MEASURING RADIATION BY USING THERMOMAGNETIC EFFECTS BELOW) CLOSE TO THE CURIE POINT. Y.Öhman.

ca Acta, Vol. 6, No. 4, 372-7 (Oct., 1959).

Some experiments are described where the rapid change ı temperature in the intensity of magnetization of Cd has been ı for the purpose of measuring radiation. By using a sensitive ınce or a sensitive measuring device resembling an astatic metometer, or induction coils, it seems possible to detect a iation of the order of 10^{-8} W. This high sensitivity assumes a uum instrument and the use of an alloy of Mg and Gd with a ie point of only 102°K.

536.3

19495 SUPERCONDUCTING BOLOMETERS AND SPECTROMETRY IN THE FAR INFRA-RED.

.Dean, G.O.Jones, D.H.Martin, P.A.Mawer and C.H.Perry.
tica Acta, Vol. 7, No. 2, 185-9 (April, 1960).

These instruments are for use in the spectral region 50-1000 μ. e sensitive element is an evaporated Sn film on mica (transition mperature ~ 3.8°K). Bolometers were made with resistances of order of 1 to 10 ohms. An example is given of the use of such olometer (minimum detectable signal 4×10^{-11} W for 3 mm^2 ight Sn surface).

536.3

19496 THE THRESHOLD SENSITIVITY OF RADIATION RECEIVERS. E.S.Ratner.

tika i Spektrosk., Vol. 9, No. 1, 101-7 (July, 1960). In Russian.

Discusses the relationship of the sensitivity threshold, governed fluctuations of absorbed quanta, with the continuous background d the properties of the receiver—amplifier—recorder system.
A.Tybulewicz

536.3

19497 THEORETICAL FOUNDATIONS OF THE METHOD OF TWO RADIOMETERS.

S.Filimonov, B.A.Khrustalev and V.N.Adrianov.
ı. tekh. Fiz., Vol. 30, No. 6, 690-8 (June, 1960). In Russian.

An analysis is carried out of Kocho's method (1950) for the differential measurement of the radiant and convective heat flow; the fundamental assumptions are checked experimentally, and the accuracy of the method is analysed. The method yields satisfactory results if $A_2/A_1 \leq 0.2$ (A_1 and A_2 are the degrees of blackness of the radiometers). Formulae have been derived for calculating the maximum relative errors. F.Lachman

536.3 : 535.8 : 621.383 : 621.317.39

19498 ELECTRICAL AND OPTICAL TECHNIQUES IN THE OPERATION OF INFRA-RED DETECTORS.

R.H.McFee.
Optica Acta, Vol. 7, No. 1, 35-46 (Jan., 1960).

The potential performance of infrared detectors can be more fully exploited by the use of proper techniques in the associated electrical and optical systems. On the basis of the equivalent circuits of the various detectors as electrical elements, proper input coupling and biasing circuits can be designed. Some of the newer detectors, indium antimonide, for example, require special methods of coupling to take full advantage of the detector's capabilities. Noise characteristics of input circuits are of great importance in many applications. Transistor circuits are readily adaptable to detector amplifiers, including the preamplifier. The great range of detector impedance values encountered demands a variety of input coupling techniques, particularly as applied to transistor amplifiers. The biasing of photoconductive detectors should be designed for the type of application. Optimum design of the biasing circuits for the detection of large signals may differ from the best approaches for threshold signal detection. For applications where wide-band electrical fidelity is required of the detector system, compensation can be applied by several methods to reduce the effects of detector time-constant roll-off. In many optical systems incorporating infrared detectors, advantages may be gained in effectiveness of the detector by the use of auxiliary optical elements closely associated with the detector. Such optics may take the form of field lenses or incoherent condensation elements, such as "light pipes". The choice among the various methods involves a number of considerations concerning optical, electrical and mechanical design limitations. With the availability of infrared transmitting materials with high refractive indices, such as silicon, germanium and arsenic trisulphide, field lens designs can be made of simple configuration with high relative aperture. Considerable gain in efficiency of some of the infrared detectors can be obtained by the technique known as "optical immersion". The detector element, usually in the form of a deposited film, is maintained in optical contact with the last surface of the field optics. In this manner, improvements in relative aperture, as well as reduction in reflection losses, are accomplished. Optical immersion may be effected by deposition of the detector surface on to the optical element, by cementing the detector to the element with a suitable substance, or by moulding an optical element around the detector.

536.3 : 539.2 : 537.312

19499 NEW INFRA-RED DETECTORS FOR THE 1 TO 7 MICRON REGION. D.H.Lee and D.H.Roberts.

Optica Acta, Vol. 7, No. 3, 271-80 (July, 1960).

Brief theoretical results are given showing the dependence of the sensitivity of solid-state detector utilizing the photoconductive and photoelectromagnetic effects on material parameters. In the light of these results, the applicability of two materials, indium and arsenide and indium antimonide, is discussed and the construction and performance of detectors made from these materials are described. Some aspects of the practical use of these detectors are discussed with particular reference to the associated circuit elements.

536.4

19500 THE USE OF PLASTIC MATERIALS AS LOW POWER INSULATORS. H.Masson.

J. Phys. Radium, Vol. 20, Suppl. No. 7, 76A-79A (July, 1959). In French.

Heating of large quantities of water by means of the sun can be easily done by the use of containers made of plastic material. Calculations necessary for such insulators, under practical conditions, are given in a simplified manner.

536.41

19501 EXPANSION COEFFICIENT OF PLASTICALLY DEFORMED STEEL. M.J.Hordon and B.L.Averbach.

Acta metallurgica, Vol. 7, No. 6, 426-7 (June, 1959).

The expansion coefficients of annealed, hardened and tempered

steel specimens were measured over the temperature range 22° to 50°C after the specimens had been strained in tension. The strain was increased in steps until necking occurred. Significant increases in the coefficient did not occur until the onset of plastic flow. There was a partial return to the unstressed value of the coefficient for the tempered steels at about 0.2% residual strain. The annealed steel showed an increase of about 1% after the initial Luders strain. After the subsequent decrease at slightly higher strains the coefficient increased again in the strain hardening region and remained constant until necking occurred. The observations are interpreted in terms of the behaviour of dislocation loops.
A.E.Kay

536.42

19502 EXCESS FREE ENERGIES FOR CONDENSED PHASES AT THE MAXIMUM AND MINIMUM MELTING-POINTS.

R.P.Rastogi, R.K.Nigam and S.Singh.
Curr. Sci., Vol. 29, No. 7, 268-70 (July, 1960).

It is suggested that ΔG_E can be computed for binary mixtures if the melting curve in the phase diagram exhibits a maximum or a minimum. ΔS_E can also be computed provided the heats of fusion of the components and of the mixture at these points are known. Results are given for mixtures of benzene halides and p- and l-carvoxime.
P.Gray

536.42

19503 THE MELTING OF A SEMI-INFINITE SOLID IN A PLANE- OR AXISYMMETRIC STREAM OF INCOMPRESSIBLE GAS. G.A.Tirskii.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 4, 785-8 (June 1, 1960).
In Russian.

A treatment of the melting of a semi-infinite solid by a stream of hot gas. The partial differential equations describing the flow near the stagnation point are formulated, both for plane and axial symmetry. A type of solution is demonstrated, for which the solid—liquid and liquid—gas interfaces remain plane and retreat at constant speed; the equations then reduce to high-order systems of ordinary differential equations.
O.Penrose

536.42

19504 THE EQUATION OF THE MELTING CURVE FOR NORMAL AND ANOMALOUS SUBSTANCES. A.V.Voronel'.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 169-73 (Feb., 1960).
In Russian.

Based on an empirical formula due to Simon and Glatzel (Zeitschrift für anorganische und allgemeine Chemie, 178, 309, 1928) an expression is derived describing the pressure dependence of melting point valid for substances that expand on solidification. The general expression obtained represents a certain law of homologous states, and as such can be used to calculate the coordinates of points at which polymorphic transformations take place in anomalous substances. The validity of the equation was confirmed by comparing the calculated data with those obtained experimentally for H_2O, Bi, Ga, and Sb. Graphs illustrating all the possible shapes of the curves of melting point versus pressure were constructed, and the coordinates of the point of the polymorphic transformation in Sb were calculated.
M.H.Sloboda

536.42

19505 INVESTIGATION OF THE MELTING POINTS OF THIN, VACUUM-DEPOSITED TIN AND BISMUTH FILMS.

L.S.Palatnik and Yu.F.Komnik.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 3, 374-8 (March, 1960).
In Russian.

It was shown that the melting points of small, vacuum-deposited Sn and Bi crystallites are a function of their size. This relationship is satisfactorily described by the formula $\Delta T = T_0 - T_r = K\Delta\sigma T_0/L_s\rho(2r)$, where T_0 and T_r are the melting points of the massive metal and of the small crystallites respectively, K a coefficient (≥4) which takes into account the deviation of the shape of the crystallites from spherical, $\Delta\sigma$ the change of the free surface energy on melting, L_s the latent heat of fusion of the metal, ρ the density, and 2r the average size of crystallites. The maximum observed value of ΔT, corresponding to $2r \cong 100$ A, was ~40° C for Sn and 55° C for Bi.
M.H.Sloboda

536.42

19506 NEW TYPE OF FREEZING-POINT APPARATUS. FREEZING POINTS OF DILUTE LANTHANUM CHLORIDE SOLUTIONS.

G.Scatchard, B.Vonnegut and D.W.Beaumont.
J. chem. Phys., Vol. 33, No. 5, 1292-8 (Nov., 1960).

A new type of freezing-point apparatus is described that reduces the errors of previous types. The freezing-point depressions of aqueous lanthanum chloride solutions up to 0.04 m are adequately expressed by the Debye—Hückel approximation for ions with a = 6.15 A plus a very small linear term. The "higher terms" are computed by combining the equations of Mayer and Kirkwood, using the tables of Poirier, and are found to be very small in this case. The parameters for the calculation of the activity of water from freezing point depressions, for the Debye—Hückel theory, and for the Kirkwood parameter B_{jk} are redetermined, and the more general use of B_{jk} is discussed.

536.4

19507 CRYOMETRY OF THE ALKALI SALTS OF OXYGENATED ANIONS IN SODIUM FLUORIDE.

A.Seyyedi and G.Petit.
J. Phys. Radium, Vol. 20, No. 10, 832-3 (Oct., 1959). In French.

Previous work [C.R. Acad. Sci.(Paris), Vol. 249, No. 4, 505 (July 27, 1959)] on the solubility of certain oxides, and in particula those of the positive metals, in sodium fluoride, indicated that the solubility of the alkali salts of oxygenated anions might be more pronounced. This study concerns the stability of anions in the chos solvent. The data indicate that the solvent properties of a salt are more a function of structure than of temperature.
H.H.Hodgso

536.4

19508 REGELATION, SURFACE DIFFUSION, AND ICE SINTERING. W.D.Kingery.

J. appl. Phys., Vol. 31, No. 5, 833-8 (May, 1960).

The freezing together of ice particles when they are brought in contact, originally described by Faraday and called regelation, is shown to occur not only at the freezing point, but also at temperatures as low as −25°C. It is shown that pressure melting is not essential to the process, nor is the presence of any unique liquid film. The welding together of ice particles occurs as a result of surface diffusion, as indicated by the time dependence and particle size dependence for the process. Surface diffusion of H_2O molecule over an ice surface is found to be rapid. Equations for the kinetics of the process are closely related to those derived for sintering phenomena, but a quantitative derivation of the surface diffusion coefficient is not obtained.

536.4

19509 CONDENSATION COEFFICIENT OF ARSENIC TRIOXIDE GLASS. A.B.Bestul and D.H.Blackburn.

J. chem. Phys., Vol. 33, No. 4, 1274-5 (Oct., 1960).

Measurements of the vaporization rate of arsenic trioxide glas at 194° C indicate that the condensation coefficient of this substance is $< 2.2 \times 10^{-6}$.
G.I.W.Llewely

536.42

19510 MASS-SPECTROSCOPIC INVESTIGATION OF THE EVAPORATION PROCESSES OF INDIUM ARSENIDE.

H.B.Gutbier.
Z. Naturforsch., Vol. 14a, No. 1, 32-6 (Jan., 1959). In German.

InAs was heated to 1000°K and the evaporation products were investigated by means of a mass spectrometer. Three stages of the process can be distinguished: (1) sublimation of As from solid InAs, and the formation of an indium enriched liquid phase at the surface; (2) evaporation of As from the liquid phase and the progressive solution of solid InAs crystals; (3) evaporation of the remaining As with exponentially decreasing rates in the form of As_4 and As_2. Energies of activation for evaporation of the two molecules of 88 ± 5 and 78 ± 5 kcal, respectively, were determined from the temperature dependence of these rates.
H.Mots

536.42

19511 THE HEAT OF SUBLIMATION AND ENERGY OF DISSOCIATION OF THALLOUS CHLORIDE. R.F.Barro

Proc. Phys. Soc., Vol. 75, Pt 6, 933-5 (June, 1960).

A new value for the standard entropy of $TlCl_c$ ($S^{\circ}_{298} = 26.59$ cal $mole^{-1}\ deg^{-1}$: Bartky and Giauque,(Abstr. 1066 of 1960) is used in a Third Law calculation of the heat of sublimation to give $D''_0(TlCl) =$ 88.0 kcal, in good agreement with spectroscopic values, which are briefly discussed.
R.F.Barrow

536.42

19512 A NUCLEAR METHOD FOR DETERMINING VERY LOW VAPOR PRESSURES. M.F.Amr El-Sayed.

Nuclear Instrum., Vol. 3, No. 6, 359-60 (Dec., 1958).

A method of determining the vapour pressure of compounds by um labelling is proposed. The advantage of this method is that neasurement of extremely low vapour pressures is intrinsically ible. The nuclear properties of tritium make it a suitable ope to use for this purpose — especially since hydrogen forms e compounds than any other element. Related thermodynamic tities that can be derived from the vapour pressure (latent heat, ecular weights and Henry's constant of solutes) can also be rmined. Chemical kinetics might use the principle of the method.

C.F.Barnaby

536.46 : 533.7 : 535.33

ABSORPTION SPECTRA OF LOW-PRESSURE FLAMES.

Abstr. 19219

536.46 : 537.56

MASS-SPECTROMETRIC STUDIES OF IONIZATION IN FLAMES.

Abstr. 19616

536.5

19513 THE TEMPERATURE SCALE 10°K TO 90°K.

F.G.Brickwedde.

s. Today, Vol. 13, No. 1, 104, 106 (Jan., 1960).

A report of a conference held at the Kamerlingh Onnes Labora-y, Leiden on 31 Aug. and 1 Sept., 1959, to discuss problems nected with the standardization of the calibration of platinum istance thermometers in this range. A first concern was the ndardization of the temperature scale itself. This will be done terms of the He gas scale (Abstr. 3398 of 1959). The purpose of conference was to foster international cooperation, although ortunately not all of the national standardizing laboratories that ibrate thermometers in this range were represented. Some reements were reached for coordinating the work of the labora-ies represented.

536.2

19514 PLATE THERMOMETER.

D.Meksyn.

angew. Math Phys., Vol. 11, No. 1, 63-8 (Jan. 25, 1960).

A fluid flows past a semi-infinite plate placed in the direction main flow. There is no heat transfer between the plate and fluid, t the heat generated by friction is taken into account. The equation energy is reduced to a linear differential equation with known efficients, and the temperature function is expressed as a double tegral which is very slowly convergent for high values of the andtl number σ. It is shown that by a change of the independent riable the integral may be expressed as a power series in σ, the st ten terms of which can be computed in the usual way. The maining terms are transformed by means of Stirling's formula d their sum then transformed by using Euler—Maclaurin's uation. The final result consisting of a few terms only can then expressed in terms of gamma functions.

S.Weintroub

536.52

19515 TEMPERATURE MEASUREMENTS OF A SOOTY FLAME.

F.Rössler.

ptica Acta, Vol. 7, No. 1, 20-34 (Jan., 1960). In German.

The true temperature of a luminous flame can only be given when e optical thickness of the flame is known. This has generally been etermined by one of two methods. Either the luminance temperature nd the colour temperature are measured, or the luminance tempera-ure of simple flame, and doubled by reflection are measured. Other ethods however are possible, in particular that of the measurement f the colour temperature of the simple and reflected flame. Calcu-ation of this, and measurements on the Hefner flame are described. he results and the sources of error in the different methods are iscussed.

536.53

19516 HOW RELIABLE ARE THE TWO NEW HIGH-TEMPERATURE THERMOCOUPLES IN VACUUM?

.W.Kuether and J.C.Lachman.

.S.A. J., Vol. 7, No. 4, 66-71 (April, 1960).

The paper gives a table of materials suitable for high-tempera-ure thermocouples and, after detailing the requirements which ust be met, reports the results of experiments on the stability f various thermocouple materials, especially 60Rh-40Ir/Ir and /Re.

E.G.Knowles

536.53

19517 USE OF CARBON RESISTORS AS LOW TEMPERATURE THERMOMETERS IN THE PRESENCE OF STRAY R.F. IELDS.

E.Ambler and H.Plumb.

ev. sci. Instrum., Vol. 31, No. 6, 656-7 (June, 1960).

536.53

19518 CARBON RESISTANCE THERMOMETRY WITH MIXED D.C. AND R.F. CURRENTS.

J.J.Gniewek and R.J.Corruccini.

Rev. sci. Instrum., Vol. 31, No. 8, 899-900 (Aug., 1960).

The dependence of the d.c. resistance at 4.0°K of an uninsulated 1 W carbon resistor of nominal 56 ohm resistance on the d.c. and r.f. power dissipation was measured in the range 0.06 to 150 μW. The resistor was immersed directly in liquid helium. The d.c. resistance at zero power was about 1760 ohms at 4.0°K. The measurements were made by means of a Wheatstone bridge, and in the r.f. case varying amounts of 10 Mc/s power from a signal generator were fed through a capacitance to the unknown resistor terminals of the bridge while the resistor was dissipating 0.5, 2 or 19 μW of d.c. power. There was no evidence of rectification. It would seem that several features of the effects indicated by Ambler and Plumb (preceding abstract) are compatible with an explanation in terms of Joule heating by induced r.f. current.

S.Weintroub

536.53 : 621.317.733

19519 IMPROVED BRIDGE FOR LOW TEMPERATURE MEASUREMENTS.

W.L.Briscoe.

Rev. sci. Instrum., Vol. 31, No. 9, 999-1000 (Sept., 1960).

Describes an improved resistance thermometer, a low temperature measuring bridge with self-indication of bridge zero. The phase of the oscillator output is inverted and these polarities are applied to the suppressor grids of two phase-comparator valves. The circuit is adjusted so that the amplified bridge signal is in phase with different valves on different sides of zero, the indicating meter being placed between the anodes of the two valves. Some additional improvements are also mentioned.

V.Bradić

536.55 : 537.52

19520 TEMPERATURE MEASUREMENTS ON A LUMINOUS ARC DISCHARGE BY MEANS OF RADIATION MEASUREMENTS.

A.Bauer.

Lichttechnik, Vol. 12, No. 7, 406-7 (July, 1960). In German.

In a high-pressure arc the plasma is nearly in thermal equilibrium and, since it emits practically as a pure temperature radiator, its temperature can be found from measurements of the radiation emitted at suitably chosen wavelengths, once the absorption within the arc itself has been determined. The method was applied to a high-pressure Xe-arc, the temperature found being in the neighbourhood of 8750°K.

J.W.T.Walsh

536.55 : 539.19

19521 POSSIBLE APPLICATION OF MOLECULAR BEAM TECHNIQUES TO THE MEASUREMENT OF SURFACE TEMPERATURES.

J.H.McFee, P.M.Marcus and I.Estermann.

Rev. sci. Instrum., Vol. 31, No. 9, 1013-14 (Sept., 1960).

Based on experimental data for the velocity distributions in beams of K atoms scattered from various solid surfaces, it is shown that the distributions are Maxwellian, and are characterized by the surface temperature. Using the velocity-selector technique [Recent Research in Molecular Beams, Marcus and McFee, New York, Academic Press, (1959)] it is thus possible to evaluate the temperature of the reflecting surface within the range, 1000°-2000°K to an accuracy of ~2%. As the resolution of the selector decreases with increase of temperature, measurements at higher temperatures will be less precise. By increasing the rotational speed of the selector by a factor of three, and subtituting a heavier atom for K, say Rb, a fourfold increase of resolving power appears quite feasible. This would result in a precision of at least 1% in the temperature range, 500° to 3000°K.

D.R.Barber

536.58 : 621.316.79

19522 TEMPERATURE CONTROL METHOD FOR USE BETWEEN 4.2° AND 77°K.

J.M.Flournoy, L.H.Baum and S.Siegel.

Rev. sci. Instrum., Vol. 31, No. 10, 1133-5 (Oct., 1960).

A simple system is described for maintaining controlled experimental temperatures between the normal boiling points of helium and nitrogen. No special apparatus is involved other than that normally required for the handling of liquid helium and the measurement of low temperatures. The technique has been used to control the temperature of a resonant cavity to within ±0.2°K, for $T > 20$°K, using a copper—Constantan thermocouple and a variable range recording potentiometer to measure temperature.

536.62

19523 CALORIMETER AND ACCESSORIES FOR VERY HIGH THERMAL RADIATION FLUX MEASUREMENTS.

J.C.Cook and H.S.Levine.
Rev. sci. Instrum., Vol. 31, No. 10, 1160-1 (Oct., 1960).

Gives details of the modification, by fitting a rotating sector to attenuate the thermal flux, of a calorimeter due to Glaser (Abstr. 2284 of 1958). E.G.Knowles

536.66

19524 ANEROID BOMB CALORIMETER FOR DETERMINING THE HEAT OF COMBUSTION OF THERMOCHEMICAL STANDARD BENZOIC ACID.

A.R.Meetham and J.A.Nicholls.
Proc. Roy. Soc. A, Vol. 256, 384-99 (July 5, 1960).

An electrically calibrated bomb calorimeter is described which has no stirred water, and is mounted in an evacuated outer jacket. Its departures from the ideal are investigated. The heat of combustion of samples from a batch of specially pure benzoic acid is found to be 26431.7 J/g under "standard bomb conditions", with an estimated standard error of 2.2 J/g. This result is compared with those of conventional calorimeters. Considerably less time per determination is needed with the new calorimeter than with a typical conventional calorimeter.

THERMODYNAMICS

536.7

19525 THE THERMODYNAMIC DESCRIPTION OF HETEROGENEOUS DISSIPATIVE SYSTEMS BY VARIATIONAL METHODS. I. A FORMULATION OF THE PRINCIPLE OF MINIMUM RATE OF ENTROPY PRODUCTION WITH APPLICATION TO CERTAIN STATIONARY HETEROGENEOUS CONVECTIVE SYSTEMS.

J.S.Kirkaldy.
Canad. J. Phys., Vol. 38, No. 10, 1343-55 (Oct., 1960).

The variational principle

$$\sigma\int_{\text{volume}} \sigma\, dV = 0, \text{ minimum},$$

where, in terms of the system's independent thermodynamic forces, X_i, the rate of entropy production per unit volume is

$$\sigma = \sum_{i,k} L_{ik}X_iX_k,$$

is known to describe the integral behaviour of certain non-convective, steady (constrained) dissipative processes since the Euler—Lagrange equations, corresponding to each degree of freedom define just sufficient steady state conditions to uniquely specify the configuration. It is herein demonstrated that this principle generates the Le Chatelier principle in the presence of constraints which are more general than previously considered. This has made possible the description of certain heterogeneous convective systems which were not previously amenable to unique thermodynamic analysis. In particular, the principle has been used to rationalize cellular or dendritic growth from the melt in alloys. The supporting observation is cited that the non-planar morphology, as compared to a planar one, leads to the maximum rate of conservation of available energy as solute segregation.

536.7

19526 THE THERMODYNAMIC DESCRIPTION OF HETEROGENEOUS DISSIPATIVE SYSTEMS BY VARIATIONAL METHODS. II. A VARIATIONAL PRINCIPLE APPLICABLE TO NON-STATIONARY (UNCONSTRAINED) HETEROGENEOUS DISSIPATIVE SYSTEMS.

J.S.Kirkaldy.
Canad. J. Phys., Vol. 38, No. 10, 1356-65 (Oct., 1960).

The variational principle

$$\sigma\int_{\text{volume}} [{}^{2}\sum_i J_iX_i - \sum_{i,k} R_{ik}J_iJ_k]\, dV = 0,$$

involving the independent thermodynamic fluxes J_i and forces X_i and subject to the non-holonomic constraint, X_i = constant, gives an expression for the integral behaviour of an unconstrained heterogeneous conduction-diffusion-reaction-viscous flow process. The validity of this expression can be checked by performing the variation with respect to the forces to obtain as Euler—Lagrange equations the phenomenological equations,

$$X_i = \sum_k R_{ik}J_k.$$

This principle allows the unique mathematical specification of certain non-stationary systems which are not easily amenable to diff ential analysis. As an example, it is demonstrated that the princ generates an approximate expression for the steady growth veloc v, of an isothermal segregation reaction in terms of the degree o advancement of the reaction, ϕ, and its derivative with respect t

$$v = \phi(v)/\phi'(v).$$

53

19527 DERIVATION OF THERMODYNAMIC RELATIONS F THREE-DIMENSIONAL SYSTEMS.

F.S.Manning and W.P.Manning.
J. chem. Phys., Vol. 33, No. 5, 1554-7 (Nov., 1960).

The relations between the first-order derivatives of the thermodynamic properties of three-dimensional systems were evaluated. The method of Jacobians which was used previously f simple or two-dimensional systems is extended, and the results presented in tabular form.

53

19528 ON THE THERMODYNAMICS OF IRREVERSIBLE PROCESSES.

K.Popoff.
Z. angew. Math. Phys., Vol. 6, No. 5, 378-86 (Sept. 25, 1955). In French.

A system maintained at constant temperature and pressure i considered, and its behaviour is found to be described by the diffe tial equation developed for an adiabatically isolated system in a previous paper (see Abstr. 7386 of 1954). The results obtained by using the function $[S - (U + pV)/T]$ as the thermodynamic potential are applied to the case of a two component two phase system, and rate of component transfer between phases is calculated. P.Gr

53

19529 ON THE GRAPHICAL REPRESENTATION OF THE PROPERTIES OF A BODY IN THERMODYNAMICS.

A.Kastler.
Z. Elektrochem., Vol. 64, No. 5, 638-41 (1960). In German.

It is suggested that the three dimensional representation $G = G(P, T)$ is one of the least complicated but most instructive, especially with regard to multiphase states. P.G

LOW-TEMPERATURE PHYSICS

536.

19530 THE LOWEST TEMPERATURE IN THE WORLD.

N Kurti.
Phys. Today, Vol. 13, No. 10, 26-9 (Oct., 1960).

Review article.

536

19531 THE POSSIBLE SUPERFLUID BEHAVIOUR OF HYDROGEN ATOM GASES AND LIQUIDS.

C.E.Hecht
Physica, Vol. 25, No. 11, 1159-61 (Nov., 1959).

It is suggested that it might be possible to preserve atomic H, D or T at relatively high densities by collecting in a magnetic field strong enough to align the electron spins and thus inhibit recombination. The critical temperatures and pressures are estimated using the quantum theory of corresponding states, and found to be negative for H and D; it is concluded that these would remain gaseous at 0°K. The possible superfluidity of H and T is discussed. R.G.Chambe

536.48 : 530

BOSE FLUID THEORY OF LIQUID HELIUM. See Abstr. 18

536.

19532 THE THERMODYNAMIC PROPERTIES OF FLUID HELIUM.

R.W.Hill and O.V.Lounasmaa.
Phil. Trans A, Vol. 252, 357-395 (March 31, 1960).

Measurements were made from which all the thermodynamic properties of fluid helium can be calculated in the temperature range from 3° to 20°K and up to 100 atm pressure. The quantities measured were: (1) the specific heat at constant volume as a function of temperature and density, (2) the pressure coefficient at a constant volume $(\partial p/\partial T)_V$ also as a function of temperature a density; (3) the pressure as a function of temperature at constant volume (isochores) for a range of densities. A particular feature of the experiments is that the important derivative $(\partial p/\partial T)_V$, from which the changes of entropy and internal energy with volume at constant temperature are calculated, was measured directly by a ential method. Starting from the known entropy and internal of the liquid near its normal boiling point, these two quanti- ere calculated for all single phase states within the experi- l range. From these, and using the equation of state data, the py, free energy, Gibbs function, and the specific heat at nt pressure are deduced. The thermodynamic functions, er with some useful state properties, are tabulated as functions perature and either volume or pressure as relevant. The of the measured quantities was such that all the thermo- ic functions except the specific heat at constant pressure were ed by integration of the experimental data; these functions ore have the same accuracy as the measured quantities, 1%.

536.48

533 EVIDENCE OF THE NATURE OF ROTATING LIQUID HELIUM. J.R.Pellam.

Rev. Letters, Vol. 5, No. 5, 189-91 (Sept. 1, 1960).

easurements of the time and position dependence of the circu- in rotating liquid helium are reported. The variation with erature of the circulation was also investigated, and is shown to unexpected behaviour. K.G.Major

536.48

534 THE HELIUM FILM FORMED FROM THE VAPOUR PHASE. L.G.Grimes and L.C.Jackson.

Mag. (Eighth Ser.), Vol. 4, 756-62 (June, 1959).

An account is given of an experiment in which the thickness of saturated" helium film formed from the vapour on a stainless mirror was compared with the thickness of the film formed the liquid phase. The thickness of the film formed from the ur was almost the same above and below the λ-point and of the thickness as the helium I film formed when the mirror was in act with the liquid. The thickness of the helium II film, with the ror in contact with the liquid, was much thicker because of the stringent isothermal conditions prevailing on the mirror ace.

536.48

9535 THE THICKNESS OF THE SATURATED HELIUM FILM ABOVE AND BELOW THE λ-POINT.

Grimes and L.C.Jackson.

Mag (Eighth Ser.), Vol. 4, 1346-55 (Dec., 1959).

Measurements of the thickness of the helium film covering a ical polished metal surface are reported for the height range 1 to 7 cm. At 2.04°K the film thickness at a height of 1 cm is $\times 10^{-6}$ cm and agrees within 2% of that determined by Ham and tson (Abstr. 856 of 1957). The thickness of the helium II film eases slightly with temperature. The results indicate that the kness of the helium I film is essentially the same as that of the um II film and confirms the theories of the film which are based arily on van der Waals' forces of attraction. Under the experi- tal conditions the thickness of the helium I film was independent emperature and practically independent of the position of the id level.

536.48

19536 THE ABSORPTION OF SOUND IN LIQUID HELIUM I UNDER PRESSURE. J.A.Newell and J.Wilks.

l. Mag. (Eighth Ser.), Vol. 4, 745-9 (June, 1959).

The absorption of 13.6 Mc/s sound waves was measured in id helium I under pressures of up to 25 atm. The absorption ies considerably with the density of the liquid, but at all peratures above about 3°K is adequately represented by the ssical Stokes—Kirchhoff expression.

536.48

19537 VISCOSITY MEASUREMENTS IN LIQUID HELIUM II. C.B.Benson and A.C.H.Hallett.

ad. J. Phys., Vol. 38, No. 10, 1376-89 (Oct., 1960).

Measurements of the viscosity of liquid helium II have been de using an oscillating sphere. This method avoids the necessity "corner" correction unavoidable when a circular disk is used, therefore eliminates the uncertainty associated with such a rection. Calibration experiments showed the presence of a nificant contribution to the observed damping of the oscillations ich arose from the viscous drag of the gas surrounding the rod ich connected the sphere with the torsion suspension fibre. This nping has been calculated and when applied to the results obtained iquid helium II, the values of the viscosity of the normal compon- which were obtained agree with those obtained by the rotating cylinder method within the combined experimental uncertainties. The assumed density of the normal fluid was that obtained from the velocity of second sound, and the most accurate thermal data available.

536.48

19538 THERMAL CONDUCTION IN ROTATING LIQUID HELIUM II. C.E.Chase.

Phys. Rev., Vol. 120, No. 3, 688-96 (Nov. 1, 1960).

When a heat current flows in a wide channel filled with liquid helium II, the resulting temperature gradient is approximately proportional to the cube of the heat current density. The establishment of this gradient requires a time τ which is function of heat current, temperature, and past history of the helium. The present experiments concern the effect of uniform slow rotation, about an axis normal to the direction of heat flow, upon grad T and τ. Grad T was measured at 0 and 1.3 rad/sec, the highest angular velocity at which this measurement could conveniently be carried out. No effect of rotation could be observed; however, an approximate calculation suggests that grad T might increase detectably at somewhat higher rates of rotation. τ was measured at a number of angular velocities between 0 and 4 rad/sec; it was found that τ was appreciably reduced by rotation, the effect being greatest at small heat currents and high angular velocities. These results can be explained on the assumption that mutual friction results from turbulence in the superfluid component, taking the form of a tangled mass of vortex line. The delay time τ characterizes the rate of growth of this turbulence when a heat current is switched on; rotation reduces τ by introducing an initial length of vortex line which accelerates this growth.

536.48

19539 DETERMINATION OF THE DIFFUSION COEFFICIENT AND THE THERMAL CONDUCTIVITY OF WEAK SOLUTIONS OF He^3 IN HELIUM II. T.P.Ptukha.

Zh. eksper. teor. Fiz., Vol. 39, No. 3(9), 896-8 (Sept., 1960). In Russian.

Measurements of thernal conductivity were made in a container with electric heating of one wall; the "effective" coefficient of thermal conductivity is then obtained as the ratio of the power used for heating and the mean gradient of temperature. Measurements were made with mixtures of 0.0001% and of 0.011% He^3, in the range of 0.7 to 2.1°K. Results are compared with a theoretical formula. It depends upon a parameter which is specific for the scattering of rotons in the mixture. This parameter enters into the thermal conductivity and into the diffusion coefficient. Comparison of theory and experiment is made by utilizing known results of diffusion experiments. Agreement of theory and experiment is satisfactory. It is found that the thermal conductivity does not depend sensitively on the concentration of the solutions at temperatures higher than 1.1°K. R.Eisenschitz

536.48

19540 GENERALIZED BARDEEN—COOPER—SCHRIEFFER STATES AND ALIGNED ORBITAL ANGULAR MOMENTUM IN THE PROPOSED LOW-TEMPERATURE PHASE OF LIQUID He^3. P.W.Anderson and P.Morel.

Phys. Rev. Letters, Vol. 5, No. 4, 136-8 (Aug. 15, 1960).

The BCS theory is extended to cover states where the particles condense into two-particle states which are not spherically symmetrical. A number of new results are obtained, one of which is that in liquid He^3 below its transition there should be a surface current sufficient to make the total angular momentum roughly $n_c l\hbar$, where l is an integer determined by the inter-particle force and n_c is the effective number of paired particles. O.Penrose

536.48

19541 NUCLEAR SPIN RELAXATION IN LIQUID HELIUM 3. F.J.Low and H.E.Rorschach.

Phys. Rev., Vol. 120, No. 4, 1111-19 (Nov. 15, 1960).

The longitudinal relaxation time of liquid He^3 was measured as a function of temperature above 1°K and of magnetic field below 13 kG in a number of sample containers. At a temperature of 2.0°K and in a magnetic field of 10 kG the longitudinal relaxation time, T$_1$, varied with the sample container from 60 to 400 sec. The transverse relaxation time, T$_2$, was measured by a new method and was approximately 30 sec at a field of 10 kG in all sample containers. T$_1$ was determined as a function of magnetic field at 2.0°K in a single sample container; the values increased from less than 50 sec in approximately zero field to 400 sec at 13 kG. An impurity relaxation model is proposed to explain the T_1 results. By assuming both wall relaxation and a bulk relaxation given by the Bloembergen, Purcell, and Pound theory, (Abstr. 2529 of 1948) the dependence of T_1 on pressure and temperature can be quantitatively understood. The low values of T_2 are inconsistent with the Bloembergen, Purcell, and Pound theory and may be due to the presence of paramagnetic impurities in suspension in the bulk liquid.

536.48

19542 SELF-DIFFUSION COEFFICIENT AND NUCLEAR SUSCEPTIBILITY OF LIQUID He^3.

A.C.Anderson, H.R.Hart, Jr and J.C.Wheatley.

Phys. Rev. Letters, Vol. 5, No. 4, 133-5 (Aug. 15, 1960).

A spin-echo method was used to measure the self-diffusion of magnetization between 0.032° and 0.15° K and the nuclear susceptibility between 0.031° and 1.3° K, both for pure liquid He^3 and for He^3 containing 1.2% He^4. Pressures ranged from 5 to 9 cm Hg. Between 0.03° and 0.1° K the diffusion coefficient varied approximately as $T^{-3/2}$ and the susceptibility was approximately constant; there was no evidence of a phase transition. O.Penrose

536.48

19543 HEAT CAPACITY OF ^{3}He-^{4}He SOLUTIONS.

R. de Bruyn Ouboter, K.W.Taconis and C. le Pair.

Physica, Vol. 25, No. 8, 723-4 (Aug., 1959).

The results cover the range from 19 to 80.5 atom per cent He^3 and the temperature range from 0.4 to 2.0°K. The discontinuities at the λ temperature agree with those derived from the vapour pressure data of Roberts and Sydoriak (Proceedings of the Fifth International Conference on Low Temperature Physics and Chemistry, Madison, 1958. p. 170). The influence of the heat of mixing below the phase separation temperature can be qualitatively described by using the theory of regular solutions with an interaction energy $W/R = 1.54°$K. H.London

536.48

19544 THERMAL CONDUCTIVITY OF ISOTOPIC MIXTURES OF SOLID HELIUM.

F.W.Sheard and J.M.Ziman.

Phys. Rev. Letters, Vol. 5, No. 4, 138 (Aug. 15, 1960).

Points out that in the experiments of Walker and Fairbank (Abstr. 12549 of 1960) the isotope scattering is so small that the resistivity due to it should be 55 times larger than is given by the Klemens formula. Apart from the uncertainty of the temperature dependence to be expected, theory and experiment are, therefore, in good agreement without invoking scattering by lines of He^3 atoms. R.Berman

536.48

19545 THERMAL CONDUCTIVITY OF SOLID He^3.

E.J.Walker and H.A.Fairbank.

Phys. Rev. Letters, Vol. 5, No. 4, 139-40 (Aug. 15, 1960).

Measurements made at different densities show that when the solid is always in the β-phase the behaviour of the conductivity is similar to that of He^4, which is also hexagonal close-packed. For a specimen of lower density there is a change in slope and a discontinuity in the log K versus 1/T curve at the α—β transition. The curves for specimens of still lower density, which are in the α-phase throughout, are very different and show a change in slope between 1.3° and 1.6°K. It is suggested that there may be two groups of phonons with different excitation energies involved in umklapp processes in the α-phase. R.Berman

536.48

19546 THERMAL EXPANSION COEFFICIENT OF SOLID He^3.

M.J.Klein and R.D.Mountain.

Phys. Rev. Letters, Vol. 5, No. 8, 363 (Oct. 15, 1960).

It is pointed out that the change in solid He^3 from antiferromagnetic to ferromagnetic ordering, predicted by Bernardes and Primakoff (Abstr. 14921 of 1960) to occur at 130 atmospheres pressure, should be accompanied by a change of the thermal expansion coefficient from negative to positive. R.G.Chambers

536.48

19547 SUPERCONDUCTIVITY.

E.A.Lynton.

Phys. Today, Vol. 12, No. 11, 26-8 (Nov., 1959).

Report of a colloquium held at Cambridge, 30 June-3 July, 1959. The first day was devoted an appraisal of the present theoretical picture. The remainder of the conference considered the experimental position and its relation to theory.

536.48 : 53

MANY-FERMION SYSTEM WITH B.C.S. INTERACTION. MODIFIED BETHE—GOLDSTONE EQUATION. See Abstr. 1727

53

19548 ON THE THEORY OF SUPERCONDUCTIVITY.

Y.Wada and N.Fukuda.

Progr. theor. Phys., Vol. 22, No. 6, 775-806 (Dec., 1959).

Bardeen, Cooper and Schrieffer's theory of superconductivit (Abstr. 1708 of 1958) is discussed by developing an exact treatment of strong coupling approximation. With respect to the ther properties, their results are verified: the energy of the ground state and the magnitude of the energy gap are found to be identic with the exact answers in the strong coupling limit. However, th argument for the magnetic properties such as the Meissner effe seems to leave some questions. The Meissner effect is discusse here by means of the gauge invariant method developed previousl (Abstr. 14925 of 1960). In order to maintain the invariance exact the case of strong coupling between electrons is investigated. Th the "interaction current" plays an essential role and is shown to diverge with the size of the system. In view of the qualitative resemblance of the BCS variational solution to that of the strong coupling approximation, it may be inferred that the above conclus seems to hold also in the weak coupling case. This will suggest t importance of the interaction current and the requirement of the exact gauge invariance,contrary to Anderson's arguments.

536.48 : 681.

19549 AN ANALOG SOLUTION FOR THE STATIC LONDON EQUATIONS OF SUPERCONDUCTIVITY.

N.H.Meye

Proc. Inst. Radio Engrs, Vol. 48, No. 9, 1603-7 (Sept., 1960).

Growing interest in the theoretical as well as applied aspects of superconductivity has focused considerable attention upon the static London equations. These macroscopic relationships descr the spatial distribution of magnetic fields and currents in superconductors. A novel analogue method of obtaining solutions in co plicated geometries is discussed. The method makes use of the similarity in form of the static London equations and the dynamic skin-effect equations of normal conduction under exponentially growing steady-state conditions. Conveniently scaled copper mod of superconducting geometries of interest can be constructed and excited from a growing-exponential function generator. Field dis utions measured in the space around the normal conductors of the model correspond with the desired distributions in the analogous superconductor geometry. Fields within conductors themselves cannot be determined directly by this method, but the surface fiel are generally most important. The method is particularly useful in studying thin films which are appreciably penetrated by magnet fields. The experimental setup and the measurement technique a discussed. Illustrative results from a copper model of a long rec angular superconducting strip 1830 penetration depths wide and 3.81 penetration depths thick are presented.

536

19550 AN ASYMPTOTICALLY EXACT SOLUTION FOR A MODEL HAMILTONIAN IN THE THEORY OF SUPERCONDUCTIVITY.

N.N.Bogolyubov, D.N.Zubarev and Yu.A.Tserkov

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 120-9 (July, 1960). In Russian.

It is shown that the whole chain of equations for the Green's function constructed on the basis of the B.C.S. model Hamiltonian can be satisfied asymptotically. Thus the asymptotic accuracy of the well-known solution for the superconducting state can be demonstrated without the application of perturbation theory. It is shown that the trivial solution corresponding to the normal state a a temperature below the critical should be rejected.

536

19551 ALTERNATIVE SUPERCONDUCTING GROUND STAT

J.C.Fisher.

Austral. J. Phys., Vol. 13, No. 2a, 446-50 (July, 1960).

Solid State Physics Conference (see Abstr. 17864 of 1960). A comparison is made between (a) the trial ground state composed a linear combination of normal state configurations in which individ electron states of opposite momentum and equal spin projection ($k\uparrow$, $-k\uparrow$) and ($k\downarrow$, $-k\downarrow$), abbreviated ($k\sigma$, $-k\sigma$), are both eithe occupied or unoccupied, and (b) the trial ground state with ($k\uparrow$, − pairing proposed by Bardeen, Cooper, and Schrieffer (Abstr. 170 1958). The two trial states lead to identical thermodynamics as long as an average matrix element $-V = \langle V'_{kk'}\rangle_{av}$ is treated as a

ıble parameter. They lead to similar coherence effects for
nic attenuation and nuclear spin relaxation. They differ in
in paramagnetism is predicted for (kσ, −kσ) pairing. Detailed
dge of the electron– phonon interaction in superconductors
at present inadequate to rule out either possiblity for all
onductors.

536.48

.52 THE PROBLEM OF THE KNIGHT SHIFT IN SUPERCONDUCTORS [OF SMALL DIMENSIONS].

brikosov and L.P.Gor'kov.
.sper. teor. Fiz., Vol. 39, No. 2 (8), 480-3 (Aug., 1960).
ssian.

is shown that the conclusion about the presence of a finite
ıt absolute zero, reached by Schrieffer and Anderson,is
eous (see Abstr. 231 of 1960).

536.48

;53 THE ENTROPY VARIATION IN SUPERCONDUCTORS WITH MAGNETIC ALLOYING. J.Müller and M.Risi.

phys. Acta, Vol. 33, No. 5, 459-62 (1960). In German.

'or superconductors in which ions with a non-vanishing spin
.ssolved, a first-order transition from the superconducting to
ırmal state (without magnetic field) has been predicted
etically. The measurement of the specific heat of a lanthanum—
inium mixed crystal shows, however, that no latent heat occurs
critical temperature.

536.48

554 COLLECTIVE EXCITATIONS IN SUPERCONDUCTORS.

K.Yosida.

r, theor. Phys., Vol. 21, No. 5, 731-44 (May, 1959).

Collective excitations are investigated on the basis of the
lyubov method (Abstr. 7034 of 1958). Confirmation is obtained
derson's result (Abstr. 5926 of 1958; 3509 of 1959), that the
ıa frequency in superconductors is completely the same as
.n the normal state. It is also shown that B.C.S.—Meissner
't is really gauge invariant.

536.48

9555 PAIR CORRELATIONS IN THE QUASICHEMICAL EQUILIBRIUM APPROACH TO SUPERCONDUCTIVITY.

..May.

gr. theor. Phys., Vol. 22, No. 1, 12-14 (July, 1959).

It is found that before a quantitative theory of superconductivity
be derived from the quasichemical equilibrium approach, a
-consistent method of evaluating the "quenched" correlation
rix for electron pairs is needed.

536.48

9556 SPIN—SPIN INTERACTION IN SUPERCONDUCTORS.

K.Nakamura.

gr. theor. Phys., Vol. 22, No. 1, 156-8 (July, 1959).

There is an interaction between the spins of ferro-magnetic
urities in a metal that is mediated by the electrons. This
raction is calculated for the normal and superconducting states
metal by means of second-order perturbation theory. The
raction is less in the superconducting state than in the normal
e, and so the impurities inhibit superconductivity. The lowering
ıe transition temperature is found to be proportional to the con-
ration of impurities and to S(S + 1), where S is the spin of the
urity ions, and this is in agreement with experiment. The
ıerical factor is calculated for lanthanum, and the result is about
of the experimental value. D.J.Thouless

536.48

19557 A NOTE ON THE ELECTROMAGNETIC RESPONSE OF SUPERCONDUCTORS. S.Nakajima.

gr. theor. Phys., Vol. 22, No. 3, 430-6 (Sept., 1959).

Based on the general formalism developed previously (Abstr.
6 of 1958), it is shown how diamagnetism and the longitudinal
transverse conductivities of a superconductor are related with
h other. In this way an interrelation is seen between recent
rks of Mattis and Bardeen (Abstr. 1482 of 1959) of Blatt and
tsubara (Abstr. 16638 of 1960) and Tinkham and Ferrell (Abstr.
96 of 1959). The infinite static conductivity still remains an
olved problem.

536.48

19558 THERMOMAGNETIC EFFECTS IN SUPERCONDUCTORS. B.T.Geilikman and V.Z.Kresin.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 502-3 (Aug., 1960). In Russian.

It is shown that transition of a metal from the normal to the superconducting state does not involve a change of the Righi—Leduc effect coefficient.

536.48

19559 CHANGES IN SUPERCONDUCTING CRITICAL TEMPERATURE PRODUCED BY ELECTROSTATIC CHARGING. R.E.Glover,III and M.D.Sherrill.

Phys. Rev. Letters, Vol. 5, No. 6, 248-50 (Sept. 15, 1960).

Au was evaporated onto one side of a 5µ mica sheet, and Sn or In, ~ 70 A thick, on the other. Charging to 150 V increased the electron atom ratio by ~ 4×10^{-5}, and displaced T_C by ~ 10^{-4} °K, downwards for In and upwards for Sn. The effect is not shown to be caused by piezoelectric strain in the mica. R.G.Chambers

536.48

19560 SUPERCONDUCTIVITY OF A FERROMAGNETIC WITH WEAK EXCHANGE INTERACTION.

S.V.Vonsovskii and M.S.Svirskii.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 384-92 (Aug., 1960). In Russian.

The effect of (s—d) exchange on the condition of existence of a superconducting state in a ferromagnetic is discussed. The effect on the characteristics of the superconducting state such as critical field and temperature and heat capacity, is also considered.

536.48 : 539.2 : 538.27

19561 CORRELATIONS BETWEEN SUPERCONDUCTIVITY AND NUCLEAR MAGNETIC RESONANCE PROPERTIES.

W.E.Blumberg, J.Eisinger, V.Jaccarino and B.T.Matthias.

Phys. Rev. Letters, Vol. 5, No. 4, 149-52 (Aug. 15, 1960).

Knight shifts, line widths and quadrupole interactions have been measured in a series of compounds V_3X (X = As, Au, Co, Ga, Ge, Ir, Pt, Sb, Si) having β-tungsten structure. Non-superconducting compounds show a temperature-independent Knight shift; in the superconducting compounds the shift (in both V and X) changes markedly as the temperature is lowered from 400^{0}K. The change is most marked for compounds of highest transition temperature. The quadrupole splitting is also largest for these compounds. R.G.Chambers

536.48 : 539.2 : 538.27

19562 NUCLEAR QUADRUPOLE RESONANCE IN SUPERCONDUCTING GALLIUM. R.H.Hammond and W.D.Knight.

Phys. Rev., Vol. 120, No. 3, 762-72 (Nov. 1, 1960).

The nuclear quadrupole resonance (n.q.r.) of Ga^{69} was investigated between 0.8 and 4.2^{0}K. (The superconducting critical temperature is 1.084^{0}K.) Progressive saturation of the resonance is produced at increasing r.f. power levels of a frequency-modulated marginal oscillator. The nuclear spin—lattice relaxation rate $1/T_1$ (sec^{-1}) is approximately $\frac{1}{2}$T (^{0}K) in the normal state. The contact part of the hyperfine interaction appears to be predominant in producing relaxation. Although the saturation method does not permit a precise determination of the constant of proportionality, the comparison of normal and superconducting relaxation rates is considerably more reliable. The r.f. fields are assumed to obey the London law of penetration, and an average r.f. field is determined in the superconductor. The relaxation rate shows a maximum enhancement by a factor 1.8 at approximately 0.95 T_C, a result which agrees with that obtained by Slichter and Hebel, and Redfield for the nuclear magnetic resonance of aluminium, and which serves as an additional experimental justification for certain features of the Bardeen—Cooper—Schrieffer theory of superconductivity. Unsaturated signal intensities in normal and superconducting states furnish a basis for estimating the penetration depth in superconducting metal spheres: λ(0) = 1200 A for an average particle diameter of 2.7µ. The n.q.r. frequency of Ga in the superconductor shifts by + 5×10^{-5} of the normal frequency (the corresponding result for indium is $\sim -10^{-2}$). This means that the contribution of the conduction electrons to the average nuclear quadrupole coupling is modified by the rearrangement of the conduction band in the superconductor. It is demonstrated that, if the quadrupole term in the hyperfine interaction were to predominate, the spin relaxation in the superconductor would have a temperature dependence like that of the ultrasonic attenuation.

536.48

19563 PRESSURE DEPENDENCE OF THE CRITICAL [MAGNETIC] FIELD IN INDIUM SINGLE CRYSTALS.

H.Rohrer.

Phil. Mag. (Eighth Ser.), Vol. 4, 1207-12 (Nov., 1959).

Calculated from measurements of length changes at the transition. It is found that

$$\partial H_c/\partial p_{||} = -[(3.4 \pm 0.2) + (2.8 \pm 0.2)t^2].\ 10^{-9}\ \text{Oe dyn}^{-1}\ \text{cm}^2$$

and

$$\partial H_c/\partial p_{\perp} = -[(0.2 \pm 0.1) + (0.1 \pm 0.1)t^2].\ 10^{-9}\ \text{Oe dyn}^{-1}\ \text{cm}^2$$

where $t = T/T_c$ and $p_{||}$ and $p_{\perp}$ are uniaxial pressures parallel and perpendicular to the tetragonal axis. The anisotropy disappears when the effect of equal length changes rather than equal pressures in different directions is considered.

536.48

19564 CRITICAL FIELD FOR SUPERCONDUCTIVITY IN NIOBIUM–TIN. R.M.Bozorth, A.J.Williams and D.D.Davis.

Phys. Rev. Letters, Vol. 5, No. 4, 148 (Aug. 15, 1960).

Susceptibility measurements indicate that Nb_3Sn at 4.2° K retains traces of superconductivity up to fields of 70 kG or more.

R.G.Chambers

536.48 : 539.2

19565 DIFFERENCE IN LATTICE SPECIFIC HEATS IN THE NORMAL AND SUPERCONDUCTING PHASES.

H.A.Boorse, A.T.Hirshfeld and H.Leupold.

Phys. Rev. Letters, Vol. 5, No. 6, 246-8 (Sept. 15, 1960).

Measurements of the specific heat of niobium are reported and analysed. Values found for the superconducting state are claimed to be less than the lattice contributions for the normal state over the same temperature range. J.W.Leech

536.48 : 532.6

19566 ANISOTROPY OF SURFACE TENSION AT THE BOUNDARY BETWEEN THE SUPERCONDUCTING AND NORMAL PHASES IN TIN. Yu.V.Sharvin and V.F.Gantmakher.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1456-70 (1960). In Russian.

The anisotropy was investigated by two methods. In one of these the structures of the intermediate-state structures, detected with the aid of a ferromagnetic powder, were observed in samples with various crystalline orientations. In the second, the moment of forces acting on a spherical sample in a magnetic field was measured. The dependence of surface tension on the direction of the normal to the phase interface and the order of absolute magnitude of the effect and its temperature dependence were determined.

536.48

19567 INVESTIGATION OF THE ANISOTROPY OF THE ENERGY GAP IN SUPERCONDUCTING TIN.

P.A.Bezuglÿi, A.A.Galkin and A.P.Korolyuk.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 7-12 (July, 1960). In Russian.

The method and results of measurement of the temperature dependence of the ultrasonic absorption coefficient (70 Mc/s) along various directions in a superconducting single crystal are presented. From the difference in the temperature variation of the ratio α_s/α_n for sound propagating along the binary C_2 and tetragonal C_4 axes of the crystal, it is concluded that the energy gap in tin is anisotropic. The width of the gap at absolute zero temperature along the C_2 direction is $(3.5 \pm 0.2)kT_c$ and along the C_4 direction $(3.1 \pm 0.1)kT_c$.

536.48

19568 APPARATUS FOR ADIABATIC DEMAGNETIZATION IN THE LIÉGE LOW-TEMPERATURE LABORATORY.

A.Van Itterbeek, J.Van Biesen and A.Dupré.

Meded. K. Vlaamse Acad. Wetensch., Vol. 21, No. 13, 9 pp. (1959). In Flemish.

Describes the experimental set-up for obtaining temperatures below 1° K by adiabatic demagnetization. Special attention is paid to the large pump-system with which it is possible to obtain a starting temperature as low as 0.8° K. The electrical circuit for measuring complex susceptibilities is described and the basic principles and suppositions of the method are mentioned. The results of preliminary measurements using iron-alum as the pa magnetic salt are reported. Technical details concerning the he insulation of the salt are discussed in connection with the possibility of extending the warming-up time of the paramagnetic salt. The lowest temperature reached is 0.06° K. The warming-up tim is of the order of $1\frac{1}{2}$ hr.

536.

19569 ON THE POSSIBILITY OF THERMOELECTRIC REFRIGERATION AT VERY LOW TEMPERATURES.

D.K.C.MacDonald, E.Mooser, W.B.Pearson, I.M.Templeton and S.B.Woods.

Phil. Mag. (Eighth Ser.), Vol. 4, 433-50 (April, 1959).

The possible use of thermoelectric cooling (primarily by the Peltier effect) for the attainment of temperatures below 1°K is considered.

536.48 : 539.1

19570 DEVICE FOR THERMAL CONTROL OF LIQUID HYDROGEN BUBBLE CHAMBERS. P.Amiot.

Nuclear Instrum., Vol. 3, No. 5, 275-7 (Nov., 1958).

One of the important problems to be solved in the constructi of hydrogen bubble chambers is the temperature control. A new device to overcome this difficulty is described. It is based on a closed circuit of pressurized hydrogen. A prototype has worked successfully. Its application to a liquid hydrogen bubble chamber has proved to be satisfactory.

536

19571 A HELIUM CRYOSTAT WITHOUT LIQUID NITROGEN COOLING. A.B.Fradkov.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 4, 829-30 (Aug. 1, 1960). In Russian.

Describes the design, in which the helium vessel is surround by a shield cooled by the escaping vapour to 72-80°K. Two litres liquid helium take 40 hr to evaporate, and nitrogen in the same cryostat lasts for 6 days. R.Berm

536

19572 PROGRESS IN CRYOGENICS. VOL. I.

Edited by K.Mendelssohn.

London: Heywood and Co. (1959) 259 + vii pp.

The first volume of a new international series which aims to review the whole field of low-temperature methods and technolog It contains 9 review articles and a preface. J.B.Bi

536.

19573 SUPERCONDUCTING CIRCUITS.

D.R.Young.

Progress in cryogenics, Vol. 1 (London: Heywood, 1959) p. 1-31.

Superconductors have three properties important in their use circuit elements: zero resistance below a critical temperature; restoration of the normal state by a magnetic field; and zero magnetic field within a superconductor, independent of an applied field In this review article the basic circuits discussed are the cryotro circuits using circulating supercurrents, a circulating-current switching device, and a latching circuit using cryotrons. The systems using superconductive devices, which are described, are a superconducting modulator, a superconducting rectifier and amplifier, circuits for performing logic, a comparison circuit, a binary adder and memory arrays. In the discussion of future developme the construction of high-capacity computers operating at He tempe tures is envisaged. J.B.Bir

536.48 : 537

19574 THERMOELECTRIC COOLING.

D.A.Wright.

Progress in cryogenics, Vol. 1 (London: Heywood, 1959) p. 33-61

The use of the Peltier effect for thermoelectric refrigeratio reviewed. The reasons for the use of semiconductors rather than metals are analysed, the choice of suitable semiconductors is discussed, and the methods of using them are outlined. Topics discussed include coefficient of performance, figure of merit, therm electric power and electrical conductivity of semiconductors, thermal conductivity of solids, choice of position of Fermi level,

:ion of performance with temperature, and the choice of semictor. The main properties of the more important semiconrs are tabulated. The general properties, thermoelectric ·, thermal conductivity, and effect of temperature on the figure rit of bismuth telluride are considered. The tellurides of lead ercury, and solid solutions and alloys of the tellurides are also ssed. Applications to cooling units are described. Major imments in materials are required to compete in efficiency with ressor-type refrigerators. J.B.Birks

536.48 : 536.2

575 EVACUATED POWDER INSULATION FOR LOW TEMPERATURES. M.M.Fulk.

ress in cryogenics, Vol. 1 (London: Heywood, 1959) p. 63-84.

Radiation is responsible for most heat losses from Dewar els, and to minimise this evacuated powder thermal insulation een developed. After a historical survey, the article discusses actors influencing the heat transport through powders and s. The apparatus and methods used for studying heat transfer gh powders are described, and detailed results are given for a er of materials. The effect of interstitial gas pressure, and fficiency of vacuum powder insulations at temperatures from to 20°K, have been studied. The relative merits of vacuum and er insulation are discussed. J.B.Birks

536.48

19576 DISTILLATION AT LOW TEMPERATURES. B.R.Brown.

ress in cryogenics, Vol. 1 (London: Heywood, 1959) p. 85-117.

The applications of low-temperature distillation are reviewed, ding the distillation of air, the separation of hydrogen isotopes liquid hydrogen, the separation of He^3 from liquid helium, the uction of B^{10} by distillation of BF_3, the purification of CO for pic studies and low-temperature distillation as an analytical . Future trends are discussed. J.B.Birks

536.48

19577 THE MEASUREMENT OF MECHANICAL PROPERTIES OF METALS AT LOW TEMPERATURES.

.Rosenberg.

gress in cryogenics, Vol. 1 (London: Heywood, 1959) p. 119-136.

This article discusses the experimental methods used for the -temperature measurement of the elastic moduli, the stress— in relationship, the tensile strength, the creep, the fatigue and internal friction of metals. J.B.Birks

536.48 : 539.19

9578 FROZEN FREE RADICALS. G.J.Minkoff.

ogress in cryogenics, Vol. 1 (London: Heywood, 1959) p. 137-78.

Research on trapped radicals falls into three main periods: the ly studies of Dewar and Vegard; the middle period when the in interest was in the products formed and deductions about bable mechanisms; and researches since 1951 using modern trumentation for the study of isolated, stabilized free radicals. this review each of these periods is considered in some detail, with more emphasis on interpretation in the later work. The hniques discussed include the isolation of radicals, infra-red dies, electronic (ultra-violet and visible) spectra, and paragnetic resonance absorption. There are 131 references.
J.B.Birks

536.48

19579 LOW-TEMPERATURE CALORIMETRY. R.W.Hill.

ogress in cryogenics, Vol. 1 (London: Heywood, 1959) p. 179-206.

This review describes the more important developments in the hniques of low-temperature calorimetry since about 1945. Calortry in four different temperature regions is considered: at liquid temperatures, below 1°K, between 4° and 20° K, and between K and room temperatures. The trends towards automatic calortry are described. The bibliography of 65 references is chosen to e the maximum amount of technical information. J.B.Birks

536.48

19580 THE DETERMINATION OF SPECIFIC HEATS BY THE TEMPERATURE-WAVE METHOD. N.V.Zavaritsky.

ogress in cryogenics, Vol. 1 (London: Heywood, 1959) p. 207-18

The flow of heat in a non-stationary state is determined by the fusivity (= thermal conductivity ÷ specific heat × density). By easurements of thermal conductivity (stationary heat flow) and diffusivity (periodic heat flow) very small specific heats can be determined. This paper discusses the theory and experimental details of the temperature-wave method, and results are given for tin in the region 0.1°-5°K. J.B.Birks

536.48 : 539.2

19581 ULTRASONIC ATTENUATION IN METALS AT LOW TEMPERATURES. R.W.Morse.

Progress in cryogenics, Vol. 1 (London: Heywood, 1959) p. 219-59.

Recent low-temperature observations of ultrasonic attenuation have shown that it is possible to observe directly the interaction of a plane harmonic lattice wave with the conduction electrons in a metal. This paper reviews the current status of this method, and discusses in some detail the experimental techniques used. The theory of attenuation by conduction electrons is considered, including phonon—electron scattering, relaxation and viscosity approximations, the attenuation for an arbitrary mean free path, and attenuation in the superconducting state. The experimental results deal with attenution in the normal and superconducting states, and with the magnetic-field dependence of attenuation. J.B.Birks

ELECTRICITY
ELECTRICAL MEASUREMENTS

537 : 541.13

19582 DETERMINATION OF THE VALUE OF THE FARADAY WITH A SILVER—PERCHLORIC ACID COULOMETER.

D.N.Craig, J.I.Hoffman, C.A.Law and W.J.Hamer.

J. Res. Nat. Bur. Stand., Vol. 64 A, No. 5, 381-402 (Sept.-Oct., 1960).

An accurate value of the faraday has been determined by the electrolytic dissolution of metallic silver in aqueous solutions of perchloric acid. Standards of electric current, mass, and time as maintained by the National Bureau of Standards were utilized in the determinations. The electric current was measured in terms of the standards of electromotive force and electrical resistance. Silver of high purity, freed from oxygen, was used. The value of the faraday was found to be 96 516.5 ± 2.4 coulombs gram-equivalent^{-1} (physical scale), 96 490.0 ± 2.4 coulombs gram-equivalent^{-1} (chemical scale). These values were obtained using 107.9028 ± 0.0013 and 107.8731 ± 0.0013, for the atomic weight of silver on the physical and chemical scales, respectively. The electrochemical equivalent of silver was found to be 1.117 972 ± 0.000 019 milligram coulomb^{-1}. This value may be used in an alternative method of defining the ampere in absolute value, namely, that steady current which will dissolve 1.117 972 mg of silver per second and depends only on the standards of mass and time. The indicated uncertainties are overall limits of error based on 95% confidence limits for the mean and allowances for the effects of known sources of possible systematic error.

537.7

19583 A SENSITIVE AND INEXPENSIVE ZERO INSTRUMENT. S.D.Mużdeka and M.I.Vidmar.

Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 6, 207-8 (March, 1956).

Describes a d.c. amplifier with a magic-eye output indicator. No component values are given. T.S.E.Thomas

537.7 : 621.375.024

19584 SIMPLE LOGARITHMIC D.C. AMPLIFIER. L.V.East and W.E.Parker.

Rev. sci. Instrum., Vol. 31, No. 11, 1222-5 (Nov., 1960).

A logarithmic d.c. amplifier circuit is described using a type 12AU7A dual triode. The amplifier output follows the equation $E_0 = 9.00 - 2\log_{10}E_i$ with an accuracy of 2% or better for positive input voltages from 5 to 500 V. The circuit parameters may be easily adjusted to compensate for tube aging and differences in characteristics between individual tubes. Output voltage drift is low and relatively independent of filament voltage drift.

537.7

19585 VACUUM-TIGHT SAMPLE HOLDER FOR HIGH TEMPERATURE CONDUCTIVITY MEASUREMENTS.

R.J.Friauf.

Rev. sci. Instrum., Vol. 31, No. 10, 1161-3 (Oct., 1960).

Gives constructional details of a container suitable for holding volatile compounds whilst electrical conductivity measurements are being made at temperatures up to 427°C. The container may be filled with an inert gas. E.G.Knowles

537.7 : 621.315.59 : 621.317.7

19586 APPARATUS FOR MEASURING AND RECORDING THE RESISTANCE OF SEMICONDUCTORS IN $\log R = f(T^{-1})$ COORDINATES.

L.G.Sapogin and V.M.Ivko.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1482-8 (July, 1960). In Russian.

Alternating currents in the range 20 c/s to 20 kc/s were used, with a 12-valve logarithmic amplifier for measuring the e.m.f. from probes on the specimen, and a 2-transistor plus 7-valve hyperbolic amplifier for measuring the e.m.f. from a thermocouple on the specimen. The outputs may be fed to a two-coordinate recording device. Full circuit details are given, and some results quoted. Among the advantages claimed are: (a) rapidity of measurement avoiding irreversible changes in the specimen; (b) zero average thermo e.m.f. in the probe circuit; (c) ease of detection of zones of high resistance, from variation of resistance with frequency; (d) the width of the forbidden zone can be found directly from the shape of the recorded characteristic; (e) the possibility of simultaneous recording of any hysteresis present. F.Quelon

537.7 : 621.317.33

19587 AN ANALYSIS OF THE CIRCUIT OF DAUPHINEE AND MOOSER FOR MEASURING RESISTIVITY AND HALL CONSTANT.

L.J.v.d.Pauw.

Rev. sci. Instrum., Vol. 31, No. 11, 1189-92 (Nov., 1960).

The Dauphinee and Mooser circuit (Abstr. 7948 of 1955) is liable to certain systematic errors due to capacitive effects in the switches. The magnitude of these errors is estimated, and it is shown how they may be eliminated by the use of suitable placed trimming capacitors and by a suitable switching sequence. The sensitivity of the circuit is also calculated.

537.7 : 621.372.6 : 621.391

19588 PRECISION INTEGRATOR NETWORKS FOR SLOWLY GROWING PROCESSES.

G.Bonnet.

J. Phys. Radium, Vol. 19, Suppl. No. 12, 140A-143A (Dec., 1958). In French.

The study of the behaviour of passive electric networks intended to assure the integration of a signal with the minimum of error shows that the quality of this behaviour can be deduced from the asymptotic expansion of this transfer function. It is possible to obtain from it the value of the error of integration in a simple analytic form. An example of an integrator network equipped with compensation was developed and the comparison of its characteristics with those of the network usually used shows that one can obtain from it, with the same conditions of error, a much less important weakening of transmission which allows it to be used for longer periods.

537.7 : 535.8

ANALYSIS OF OSCILLOGRAMS BY MEANS OF A TRAVELLING MICROSCOPE. See Abstr. 19391

ELECTROSTATICS . DIELECTRICS

(The study of solids through their dielectric properties is included under Solid-State Physics; similarly for Liquid State and Gaseous State)

537.2

19589 PROBLEMS IN ELECTROSTATICS.

D.S.Ainslie.

Amer. J. Phys., Vol. 28, No. 8, 724-6 (Nov., 1960).

Despite the fact that the study of electrostatics has been carried on for centuries, the problems as to why there is a transfer of electricity when dissimilar substances are rubbed together and how this transfer is facilitated by the rubbing process have not been answered satisfactorily. In this paper some experimental work in electrostatics which gives results in contradiction to the treatment of this topic, given in many elementary text books of physics, is described.

537.2 : 530.16

DIELECTRIC FORMULATION OF QUANTUM STATISTICS OF INTERACTING PARTICLES. See Abstr. 18988

53

19590 INEQUALITY OF PARTIAL-CAPACITANCE CHARG AND RESULTANT-FIELD FLUXES.

L.R.Neiman and K.S.Demirchyan.

Elektrichestvo, 1960, No. 6, 1-6 (June). In Russian.

In a system of n charged bodies, the capacitance, the potentia difference and the electric displacement flux along the line of a resultant field between the k-th and p-th bodies are C_{kp}, $U_{kp} = U_k$ and Ψ_{kp} respectively. By Maxwell's equations, the total charge q of the k-th body is $q_k = \sum_{p=1}^{n} C_{kp}U_{kp} = \sum_{p=1}^{n} \Psi_{kp}$, but, in general $C_{kp}U_{kp} \neq \Psi_{kp}$. This article explains the reason for the latter inequality in a more easily comprehended form than that given by Meerovich and Redkin (Abstr. 4028 of 1958) by considering physic the resultant field and how it varies with the potential of one of th bodies. D.E.Bro

537

19591 ELECTRIFICATION OF CARBON BLACK BY CONTACT WITH A METAL SURFACE.

C.J.Brasefield.

J. Franklin Inst., Vol. 270, No. 4, 283-90 (Oct., 1960).

A measured quantity of carbon black was allowed to slide down a steep surface of nickel (presumably oxidized) which was electrically grounded and the charge acquired by the carbon black was determined. Blacks were selected whose oxygen content varied from 0.4 to 11.6 per cent. It was found that a black of low oxygen content acquired a large positive charge and the the charg decreased with increasing oxygen content, becoming zero for 4 pe cent oxygen and negative for larger oxygen contents. It thus appe that the electron affinity of carbon black increases with increasin oxygen content of the black. The positive charge acquired by a black of low oxygen content was found to decrease as the black wa heated to higher temperatures, presumably because of increasing oxygen content of the black. The oxidation of certain blacks is no permanent if the temperature reaches only 400°C but is permane if it reaches 600°C. The oxygen content at a particular temperat ceases to increase after the first 30 sec at that temperature. Th oxidized surface of carbon black which is responsible for its high electron affinity cannot be produced by prolonged exposure of a black to atmospheres of CO, CO_2, or C_3O_2. Cigarette smoke is usually negatively charged, but if the cigarette is heated to 300°C the smoke is positively charged, as though the electron affinity of the tobacco had been increased by oxidation.

53

19592 ELECTRIC POLARIZABILITY OF A SHORT RIGHT CIRCULAR CONDUCTING CYLINDER.

T.T.Taylor.

J. Res. Nat. Bur. Stand., Vol. 64B, No. 3, 135-43 (July-Sept., 196

A method similar to that employed by Smythe (Abstr. 8159 of 1956) for calculating the capacitance of a freely charged short right circular conducting cylinder is used to calculate the electric polarizability tensor in the principal axis system for such a cylin Calculations to an accuracy of approximately five significant figures are carried out for cylinders with radius to half-length ratios of $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, and 4. The results are applicable to the desi of artificial dielectrics.

53

19593 APPLICATION OF A VIBRATING PROBE TO THE MODELLING OF FIELDS BY THE INDUCED CURREN METHOD.

G.M.Gershtein.

Zh. tekh. Fiz., Vol. 30, No. 6, 734-6 (June, 1960). In Russian.

It is possible to obtain field plots near electrode structures b means of a vibrating probe (charged dielectric rod). Current indu by the probe into an external network is proportional to the potent gradient in the direction of vibration. Factors affecting the frequency of vibration and range of application are discussed. A.E.I. Research Laborat

53

19594 POTENTIAL DISTRIBUTION UNDER A CYLINDRICA PROBE.

A.L.Éfros.

Zh. tekh. Fiz., Vol. 30, No. 9, 1024-9 (Sept., 1960). In Russian.

The potential problem is solved for a semi-infinite medium ($z < 0$) and a cylinder of radius r_0 placed along the z-axis ($z > 0$). A Fourier—Bessel series describes the potential inside the er; the potential in the semi-infinite medium is expressed in oidal co-ordinates, in terms of Legendre functions. Two ssive approximate solutions are formulated and their accuracy npared. J.K.Skwirzynski

537.2 : 621.319.339

595 FUNCTION OF THE COLLECTING ELECTRODE IN A VAN DE GRAAFF GENERATOR. K.S.Subudhi.

ar Instrum., Vol. 3, No. 6, 341-3 (Dec., 1958).

n the Van de Graaff electrostatic generator the electric charge igh voltage is stored on a metallic collecting electrode. In Van de Graaff et al. stated that the spherical collecting elec- is similar to a Faraday's ice-pail. A new explanation of eneration of the high voltage in the above generator was nted in 1954 by Simon. It is based on a different fundamental iple, namely, the Volta's condensing electroscope principle. n concluded that if the spraying system is maintained at a con- potential, the collecting electrode will also attain a constant tial, the magnitude of which will be proportional to that of the ing system. The factor of proportionality does not depend on apacity of the collecting electrode but depends on the height of achine. The results of the experiments performed on a self- ing generator of Becker type indicate that the voltage of the rator does not depend on the metallic sphere and the voltage is ases as the height is increased even though the same collecting m is used. This is qualitatively in accordance with the Simon's y.

CURRENT ELECTRICITY
ELECTROKINETICS

(The study of solids through their electrical conduction properties is included under Solid-State Physics)

537.3 : 621.317.32

9596 A MEASURING DEVICE FOR SMALL D.C. VOLTAGES BY CONVERSION THROUGH A PHOTO-RESISTOR. raschev.

Acad. Bulg. Sci., Vol. 12, No. 2, 101-4 (March-April, 1959). erman.

The d.c. voltage to be measured is applied across a divider de up from a fixed and a photo-resistor (cadmium sulphide stal). Illumination of the photoresistor by a low frequency t source results in the development of an alternating voltage oss the photoresistor, which is then amplified and detected. liminary results show that for an input impedance of 10^9 ohm, ng-term stability of 15×10^{-6} volts, a time constant of 3 seconds a linearity of better then 2.5% over the range $0 - 600 \times 10^{-6}$ ts is possible. Methods of improving the performance are out- d. N.Murcott

537.3

19597 A THEORY OF THE TRANSVERSE THERMAL GALVANOMAGNETIC EFFECT IN A FERROMAGNETIC NDUCTOR. N.P.Patrakhin.

Metallov. i Metallovedenie, Vol. 7, No. 4, 491-4 (1959). In ssian.

A theory of the Ettingshausen effect in ferromagnetics is given sed on the s—d exchange model. It appears that the effect of the ernal field of the ferromagnetic should be similar to its effect the Hall effect (1952) but no experimental results are available. r a theory of the Nernst—Ettingshausen effect based on the same del, see Patrakhin, Fiz. Metallov i Metallovedenie, Vol. 6, No. 3, 58. A.F.Brown

537.312

19598 COSINE CORRECTION OF A WEATHERPROOFED PHOTOVOLTAIC CELL. E.T.Weston and D.Paix.

sci. Instrum., Vol. 37, No. 9, 359-60 (Sept., 1960).

The note describes the construction of a special correcting vice known as a "cosine corrector" which was completely pervious to the weather. R.Bullough

537.32

19599 BIBLIOGRAPHY OF THERMOELECTRICITY. M.J.Goodall and J.E.R.Young.

nchester (Hants, England): IBM World Trade Laboratories ne 1, 1960) 72 pp. [Bibliography No. 1].

537.32

19600 PELTIER COEFFICIENT AT A SOLID—LIQUID INTERFACE. J.R.O'Connor.

J. appl. Phys., Vol. 31, No. 9, 1690-1 (Sept., 1960).

If a current traverses a stationary liquid—solid interface, the Peltier heat causes a displacement of this interface. Expressions are given which relate the displacement and the initial displacement velocity to the Peltier and Thomson coefficients. H.London

537.32

19601 STUDIES OF THE EFFICIENCY OF DEVICES USING SOLAR ENERGY IN A DYNAMICAL SYSTEM. M.Touchais and J.Oualid.

J. Phys. Radium, Vol. 20, No. 6, 649-51 (June, 1959). In French.

The thermoelectric solar energy convertor is considered theoretically and the conditions for maximum power gain (the ratio of electric power output to total solar input) are discussed. Experimental values are given for the reflection factor and emissive power in visible light for various metal plates with polished, oxidized, bloomed and chemically treated surfaces. N.Murcott

537.32 : 536.2

19602 A REGENERATIVE SCHEME OF THERMOELECTRIC COOLING. A.I.Burshtein.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1608-16 (July, 1960). In Russian.

Calculations are made for a system in which the heat from the junctions of a battery of thermocouples is carried away by a constantly circulating fluid. As it circulates, the fluid is first cooled by one side of the battery, then takes up heat from some cold body, then is heated by the other side of the battery, and finally is cooled externally before it circulates again. It is shown that there is a maximum useful temperature drop across the end of the cooling system; the other extreme case, which gives maximum efficiency, of a very small temperature drop is considered. The variation of the temperature through the system, the conditions for the process to be stationary, and the efficiency of the scheme for various temperature conditions are calculated. D.J.Thouless

537.32 : 536.48

THERMOELECTRIC COOLING. See Abstr. 19574

537.36

19603 THEORY OF THE DIFFUSE DOUBLE LAYER. F.H.Stillinger, Jr and J.G.Kirkwood.

J. chem. Phys., Vol. 33, No. 5, 1282-90 (Nov., 1960).

The charge moment expansion for potentials of mean force acting between the ions of an electrolyte is reviewed in a form applicable to surface phases. An integral equation is in this manner derived for approximate determination of the average charge distribution near a planar electrode. The solution of the linearized equation is constructed for an electrolyte consisting of charged hard spheres suspended in a dielectric continuum. For very dilute solutions, the predictions of the linearized Poisson—Boltzmann equation are verified; at higher concentrations, the average space charge in the neighbourhood of the electrode tends to alternate in sign as a result of local latticelike ion arrangement imposed effectively by short range ion repulsions. Predicted values of the ζ potential relative to those of the linear Poisson—Boltzmann theory are reported.

537.36

19604 RELATION BETWEEN THE FORCE OF VISCOUS FRICTION AND THE STREAMING POTENTIAL [OF THE ELECTRIC DOUBLE LAYER]. L.V.Gorelik.

Zh. tekh. Fiz., Vol. 30, No. 6, 653-5 (June, 1960). In Russian.

This note is concerned with the flow of polar liquids through the pores of solid bodies. Previous authors established a formula relating the gradients of potential and pressure and claimed its validity in stationary flow. The formula is now modified in such a way that the pressure gradient is replaced by the negative viscous force per unit volume which the liquid exerts on the solid body. This formula is supposed to have a wider range of validity. R.Eisenschitz

537.36

19605 A STUDY OF THE RELATION BETWEEN ELECTROKINETIC POTENTIAL AND SURFACE CHARGE DENSITY. D.A.Haydon.

Proc. Roy. Soc. A, Vol. 258, 319-28 (Oct. 25, 1960).

The problem of relating electrophoretic mobilities to surface change densities of particles in suspension was investigated mainly experimentally. The subject was approached by comparing the surface potentials at an oil/water interface calculated for adsorbed films of ionic surface active agents, with the zeta potentials of oil droplets in similar surface-active agent solutions. When the bulk viscosity and dielectric constant were used in calculating the zeta potentials, the surface and zeta potentials converged towards low surface charge densities. At higher charge densities the zeta potentials fell well below the surface potentials. The reasons for this discrepancy were investigated. Misapplication of the Gibbs equation, surface hydrolysis of adsorbed ions, specific interaction of adsorbed ions with counter-ions, surface conductivity, internal circulation in the liquid droplets and double-layer dielectric constants and viscosities were considered. By elimination it was concluded that only enhanced values of the η/D ratio in the electrical double layer can account for the experimental observations. Independent evidence for this phenomenon was briefly examined. The circumstances under which a reliable value of surface charge may be determined from electrophoretic measurements were discussed.

IONIZATION

537.56

19606 **A SIMPLE METHOD OF CALCULATING THE DEGREE OF IONIZATION AND THERMODYNAMIC FUNCTIONS OF A MULTIPLY IONIZED IDEAL GAS.** Yu.P.Raizer.
Zh. eksper. teor. Fiz., Vol. 36, No. 5, 1583-5 (May, 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 36(9), No. 5, 1124-5 (Nov., 1959).

The method is based on the use of approximations which convert the Saha and thermodynamic equations into differential form. Some results are quoted for the case of air. A.H.Gabriel

537.56

19607 **ESTIMATION OF THE IONIZATION POTENTIAL AND DISSOCIATION ENERGY OF MOLECULAR ASTATINE.** R.W.Kiser.
J. chem. Phys., Vol. 33, No. 4, 1265-6 (Oct., 1960).

By using extrapolation of empirical relationships, values of 8.3 eV and 1.2 eV are deduced for the ionization potential and dissociation energy, respectively, of At_2. G.I.W.Llewelyn

537.56

19608 **THOMAS—FERMI MODEL OF POSITIVE ION.** S.Kobayashi.
J. Phys. Soc. Japan, Vol. 14, No. 8, 1039-54 (Aug., 1959).

Exact solutions of the Thomas—Fermi equation for a positive ion were obtained (including their derivatives) by "inward" numerical integration. The whole range of the degree of ionization of physical interest was covered in sufficient detail to permit accurate interpolation for intermediate regions. Using these numerical solutions, several physical quantities of free positive ions were investigated.

537.56

19609 **CALCULATION OF PHOTO-IONIZATION ABSORPTION.** L.M.Biberman and G.É.Norman.
Optika i Spektrosk., Vol. 8, No. 4, 433-8 (April, 1960). In Russian.

Gives a theoretical basis of photo-ionization absorption by atoms more complex than hydrogen and derives simple approximations for photo-ionization cross-sections of complex atoms whose excited states obey the Boltzmann distribution law. The expressions obtained for the absorption coefficient, together with Kirchhoff's law, make it possible to calculate emissivity due to recombination of electrons with ions. A.Tybulewicz

537.56 : 539.19

PHOTOIONIZATION EFFICIENCIES OF Br_2, I_2, HI AND CH_3I.
See Abstr. 17720

537.56 : 539.19

19610 **THE DISSOCIATION OF FAST H_2^+ IONS BY HYDROGEN.** D.R.Sweetman.
Proc. Roy. Soc. A, Vol. 256, 416-26 (July 5, 1960).

H_2^+ ions of energy 100 to 800 keV were passed through hydrogen gas and the cross-sections for the following four processes dete mined: (1) $H_2^+ \rightarrow H^+ + H^0$, (2) $H_2^+ \rightarrow H^+ + H^+$, (3) $H_2^+ \rightarrow H^0 + H^0$, (4) $H_2^+ \rightarrow H_2^0$. A magnetic field was used to separate the fast dis ation products of different e/m, and CsI:Tl scintillation crystals used as detectors. Double-height pulses resulted when two parti cles of the same e/m simultaneously entered one of the crystals were clearly resolved from single pulses. Processes (3) and (4) were separated by moving a fine slit across the neutral-particle counter which thus counted only H_2^0 particles as double pulses. T partial cross-sections for processes (1) and (2) show an E^{-1} depe dence at high energies. The energy dependence is less marked b 300 keV, where the Born approximation might be expected to be invalid. The partial cross-sections for processes (3) and (4) sho the strong energy dependence characteristic of an electron-excha process. The angular distribution for process (3) is consistent w the reaction proceeding via the $1^3\Sigma_u$ repulsive triplet state. The large fraction of the capture reactions proceeding this way (70%) reasonable considering the high probability of formation in the tr let state. The large values of the cross-sections for processes o than simple dissociation account, in part, for the considerable dis crepancies between the results of other workers.

537.

19611 **IONIZATION OF FAST Na, K, Rb, AND Cs ATOMS O COLLISION WITH H_2, D_2, N_2 AND O_2 MOLECULES.** Yu. F. Bȳdin and A.M.Bukhteev.
Zh. tekh. Fiz., Vol. 30, No. 5, 546-54 (May, 1960). In Russian.

Ionization cross-sections were measured as functions of the incident-particle energy in the range 150-2200 eV. Energy thresholds for the ionization process were found to be 740 eV (Cs, H_2), 360 eV (Cs, D_2), 490 eV (Rb, H_2) and 280 eV (Rb, D_2). The apparatus employed is described and the results obtained are interpreted in terms of the quasi-adiabatic approximation. S.Chom

537.56 : 539.

19612 **COLLECTION OF IONS PRODUCED BY ALPHA PARTICLES IN AIR.** Z.Bay and H.H.Seliger.
Phys. Rev., Vol. 120, No. 1, 141-3 (Oct. 1, 1960).

In the measurement of the ionization caused by alpha particle in air, recombination effects between slowly moving positive and negative ions (the latter formed by electron attachment to oxygen) have to be considered. The usual procedure in such measurement is to determine the saturation current (by extrapolation of reciprocal current versus reciprocal voltage curves to infinite field strength) according to the Jaffé theory. The paper by Wingate, Gross, and Failla (Abstr. 4501 of 1957) has cast doubt on the valid ity of this extrapolation technique, in that the authors propose a field-independent part of the recombination amounting to 3.3% at atmospheric pressure in air. This proposal implied that all previous measurements of W_α for air were in error by this amount and that this error is a possible cause for the reported difference (3-4%) between W values for alpha and beta particles in air. In view of their own W measurements the authors felt compelled to r examine this supposedly field-independent part of the recombinati Approximating the experimental conditions of Wingate, Gross and Failla, the authors have not been able to reproduce this effect and the experiments demonstrate the validity of the usual extrapolatio techniques.

537.56 : 539.

19613 **THE IONIZATION BY POLONIUM ALPHA PARTICLES IN AIR AND THE AVERAGE ENERGY [W] TO MAKE A ION PAIR.** W.P.Jesse.
Radiation Research, Vol. 13, No. 1, 1-18 (July, 1960).

W was measured in air, in N_2 and in C_2H_4, the gas pressure in cases being 5 cm Hg so that the loss of ions by recombination was very small. The values of W were 34.96 ± 0.07, 36.39 ± 0.07 and 28.03 ± 0.05 respectively. Preliminary experiments on the ionization in air resulting from single α-particles of energy from 1 to 5 MeV are also reported. J.Dutt

537.56 : 533.

19614 **ON THE DISCHARGE MECHANISM OF PHILIPS IONIZATION GAUGE (P.I.G.).** N.Miyagawa.
Sci. Pap. Inst. Phys. Chem. Res. (Tokyo), Vol. 54, 6-15 (March, 1960).

Experimental data indicate the following discharge mechanis The discharge is mainly sustained by the ionization of gas molecules on the median plane between the cathodes. On this plane,

ectrons which cause this ionization are set in motion in
ner similar to the electrons in the case of the B-type oscil-
of a split-anode magnetron. This would seem due to the
ignment of the electrodes resulting in distorted concentric
otential lines.

537.56 : 539.12

ELATIVE IONIZATION OF PROTONS NEAR THE END OF
R RANGE. See Abstr. 20141

537.56

515 **HIGH-ENERGY OXYGEN IONS IN CARBON DIOXIDE MASS SPECTRA.** R.M.S.Hall.

e (London), Vol. 187, 683 (Aug. 20, 1960).
n mass spectra of carbon dioxide a high-energy state in
en ions was observed. The most probable mechanism is
$\to CO^+ + O^+$. The ratio between the ions of high-energy state
he thermal energy ions was affected by variations in the ion
ller voltage. Low voltages, down to 0.5 V, favoured the high-
gy state, whereas higher voltages, up to 8V, gave predominantly
mal-energy ions. R.Schnurmann

537.56 : 536.46

616 **MASS-SPECTROMETRIC STUDIES OF IONIZATION IN FLAMES. I. THE SPECTROMETER AND ITS APPLICA-**
N TO IONIZATION IN HYDROGEN FLAMES.

Knewstubb and T.M.Sugden.

c. Roy. Soc. A, Vol. 255, 520-37 (May 10, 1960).
An apparatus is described for the extraction of ions from flames
ing at atmospheric pressure, and for the subsequent mass
ysis of the ions. It consists essentially of a fine leak in a
inum or quartz diaphragm on which the flame is played, and on
other side of which a low pressure is maintained by pumping.
ions are separated by suitable disposition of electrodes in a
ies of expansion chambers before passing into the analyser. It
oncluded that secondary ionization is not important in the mass
ctrometer, and that charge-exchange reactions and other related
es of reaction, in so far as they occur inside the spectrometer,
gely reflect similar reactions occurring in the external flame. Ionic
centrations as low as 10^5 per cm^3 can be measured for ions ranging
mass from 10 to 400 atomic units. A brief account is given of
ionization observed from premixed flames of hydrogen, oxygen
nitrogen. The most evident positive ion was hydroxonium
O^+), the other important ones being NH_4^+ and NO^+. The first
of these also occurred in hydrated forms, associated with up to
molecules of water. These hydrates occur to a large extent in
cooler parts of the flame system (just before the reaction zone),
are considered to be a secondary phenomenon, possibly formed
association just inside the entry leak into the spectrometer.
perimental evidence is adduced for the formation of H_3O^+ in the
nogeneous gas phase in and near the reaction zone, rather than
catalytic interaction with the walls of the leak. The most likely
ction is considered to be $H + H + OH = H_3O^+ + e^-$ and the kinetics
this are considered. Doubts about the heat of formation of this
, and about that of the NH_4^+ ion preclude quantitative decisions on
ny points. The ionization of nitric oxide is shown to be essentially
hermal phenomenon, by observations of ionization with known
ounts of nitric oxide added to the flame gases. The relatively
w rate of recombination observed beyond the reaction zone is
cussed, and found to be in line with previous results.

537.56

19617 **THREE-BODY RECOMBINATION OF GASEOUS IONS.** T.Fueno, H.Eyring and T.Ree.

nad. J. Chem., Vol. 38, No. 10, 1693-701 (Oct., 1960).
The recombination of gaseous ions in the presence of third
dies is assumed to follow a sequence of two bimolecular steps:
$+ X^+ \rightleftharpoons MX^+$ and $MX^+ Y^- \to XY + M$. The termolecular rate
nstants of the over-all processes are calculated for several
ized gases at various temperatures. For the calculation, the
uilibrium internuclear separation and the corresponding binding
ergy of a complex ion, MX^+, are obtained by minimizing the inter-
tion energy between M and X^+, which is approximated to the sum of
Lennard-Jones potential for the M-X interaction and the polariza-
n energy between M and X^+. The recombination coefficients of
me ionized gases at 288°K and various pressures are calculated
compared with the observed data. The agreement is found to be
isfactory. The limitations of this theoretical approach are
cussed.

537.56 : 551.5

SMALL ION CHARACTERISTICS. See Abstr. 18479

537.56

19618 **COULOMB SCATTERING IN A MAGNETIC FIELD.** P.A.Sweet.

Phil. Mag. (Eighth Ser.), Vol. 4, 1155-9 (Oct., 1959).

It is shown that the contributions of distant encounters to the velocity diffusion coefficients in Coulomb scattering are convergent when a magnetic field is present, and that no cut-off is required in the impact parameter. A cut-off is, however, required in the coefficient which defines space diffusion across the field. In a plasma the diffusion coefficients are slightly reduced when the typical gyromagnetic radius of the particles is less than the Debye length.

537.56

19619 **MEASUREMENT OF THE MOBILITIES OF GASEOUS IONS BY THE PAUL LANGEVIN ANALYSER.**

E.Montel.

J. Phys. Radium, Vol. 20, No. 7, 697-701 (July, 1959). In French.

After a few improvements had been made on the mechanical parts of the apparatus, the best conditions for measurement have been determined, in rather dry air. For that purpose, the variations of the ionization current of both signs, with the azimuth of the collecting electrode, were determined. The curves of variation of current have been drawn, first when the potential U between the fixed cylinders is constant, while the rotational speed of the middle one is varying; then when the speed is constant and U varying. The slower the rotation speed, the sharper are the peaks of the curves. According to the theory of the apparatus, the abscissa of the maximum is related to a value of the mobility, the meaning of which is debatable, on the account of the fact that only one of several stable kinds of ions are present in the gas.

537.56

19620 **THE MOBILITIES OF IONS IN MOLECULAR GASES.** A.M.Arthurs and A.Dalgarno.

Proc. Roy. Soc. A, Vol. 256, 552-8 (July 19, 1960).

A formula is derived for the mobility of an ion in a diatomic molecular gas and quantitative results are obtained for mobilities in the limit of vanishing temperature. As an example of the detailed application of the theory, a calculation is given of ion mobilities in molecular hydrogen and molecular deuterium, for which it is necessary to take account of the rotational distributions. It is shown that in contrast to atomic gases for which the low-temperature mobilities are independent of temperature, in molecular gases the low-temperature mobilities decrease as the temperature decreases, ultimately passing through a minimum at some very low temperature.

537.56

19621 **THE NUMBER OF ACCELERATED PARTICLES IN AN IONIZED GAS UNDER VARIOUS ACCELERATING MECHANISMS.** A.V.Gurevich.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1597-607 (1960). In Russian.

The kinetic equation is solved for a system of particles interacting according to Coulomb law under conditions when the distribution function in the high-velocity range is not stationary due to the presence of an accelerating mechanism, that is, under conditions when the accelerating mechanism leads to continuous acceleration of the particles whose energy is larger than the injection energy. The magnitude of the particle flux is determined.

537.56

19622 **DETECTION OF NEGATIVE IONS FORMED BY CHARGE TRANSFER.** T.M.Donahue and F.Hushfar.

Nature (London), Vol. 186, 1038-9 (June 25, 1960).

The cross-sections for electron-loss from hydrogen atoms moving with energies of 5-40 keV through target gases such as carbon monoxide are approximately $(1\text{-}5) \times 10^{-16}\ cm^2$, and have resonance peaks of about $10^{-16}\ cm^2$. A collision process is proposed in which the atomic electron is first liberated before being captured by the target molecule, in the presence of the proton, to form a negative ion. The predicted energies of the free electrons agree with the threshold potentials for the formation of negative ions, which are detected by means of a mass-spectrometer.

K.A.Thomas

537.56

19623 INTERCHANGE OF CHARGE BETWEEN GASEOUS MOLECULES.

D.Rapp and I.B.Ortenburger.
J. chem. Phys., Vol. 33, No. 4, 1230-3 (Oct., 1960).

The theoretical methods for calculation of charge-exchange cross-sections of Gurnee and Magee (Abstr. 7987 of 1957) have been applied to the reactions of H atoms with H^+, O^+, and N^+. The agreement with experiment (Abstr. 13408-9 of 1960) is excellent considering the approximations involved in the theory.

537.56

19624 EFFECTIVE CHARGE OF HEAVY IONS IN VARIOUS MEDIA.

P.G.Roll and F.E.Steigert.
Phys. Rev., Vol. 120, No. 2, 470-3 (Oct. 15, 1960).

Effective-charge data for heavy ions, as obtained from range—energy curves in oxygen, argon, aluminium, and nickel are analysed in terms of a Fermi—Thomas representation of the atom. It would appear that this gives a superior parametrization in terms of nuclear charge. In addition, it appears to account properly for the increase in charge observed for metallic as compared to gaseous absorbers.

537.56

19625 EXPERIMENTS ON CHARGE-CHANGING COLLISIONS OF LITHIUM IONIC AND ATOMIC BEAMS.

S.K.Allison, J. Cuevas and M.Garcia-Munoz.
Phys. Rev., Vol. 120, No. 4, 1266-78 (Nov. 15, 1960).

Beams of Li^+ ions accelerated to kinetic energies in the range 10-475 keV were brought into charge equilibrium in the gases H_2, He, and N_2 and the fractional amounts of Li^-, Li^0, Li^+, Li^{2+}, Li^{3+} measured. Because of the relatively large amount of Li^- in an equilibrated beam below 40 keV in energy in propane and nitrous oxide, limited investigations were carried out in these gases. The anomalously large Li^{2+} yield in helium at Li^7 energies below 100 keV was noted. By holding each separated charged constituent successively in an orbit in a magnetic field, admitting gas, and observing the beam attenuation, the total cross-section for all charge-changing collisions was observed. Through application of the differential equations for growth or decay of a charged component, certain individual charge-changing cross-sections can be deduced from these observed sums. Values are given for $(\sigma_{\bar{1}0} + \sigma_{1\bar{1}})$, σ_{01}, σ_{10}, σ_{12}, σ_{21}, and $(\sigma_{32} + \sigma_{31})$ in H_2, He, and N_2 target gases throuout the energy range. Upper limits can be assigned to $\sigma_{0\bar{1}}$, $\sigma_{1\bar{1}}$, σ_{13}, and σ_{23}. Use of data on $\sigma_{1\bar{1}}$ in H_2 from other sources provides values of $\sigma_{0\bar{1}}$ in that gas. Values for σ_{21} for Li^{2+} in helium gas, compared, at common velocities, with σ_{10} for He^+ in helium, and σ_{01} for H^0 in helium, show the exchange nature of the He^+He interaction compared to that of the other isoelectronic structures.

537.56

19626 EFFICIENT PRODUCTION OF MULTIPLY CHARGED POSITIVE IONS BY LOW ENERGY STRIPPING IN HELIUM GAS.

S.K.Allison, J.Cuevas and M.Garcia-Munoz.
Rev. sci. Instrum., Vol. 31, No. 11, 1193-7 (Nov., 1960).

"Low energy" as used in this report means ionic and atomic beam velocities from approximately 5×10^7 to 2×10^8 cm sec^{-1}. In this velocity region an ion beam brought to charge equilibrium in helium gas has a much greater content of components of high positive charge than does the same beam charge equilibrated in other gases. To achieve this effect, however, the pressure of helium gas in a charge stripper or converter cell placed in the beam path must be much higher than in other gases. The predicted effect, calculated from the charge changing cross-sections, is verified by experiments on the stripping of Li^+ to Li^{++} in air and helium. In a qualitative experiment the proton beam of the Chicago synchrocyclotron was increased 100% by equilibrating the hydrogen constituent in a 90-10 HeH^2 mixture before issuing it from the ion source into the acceleration chamber.

537.56 : 541.12

19627 ION—MOLECULES REACTIONS OF THE FIFTH GROUP ELEMENT HYDRIDES.

A.Giardini-Guidoni and G.G.Volpi.
Nuovo Cimento, Vol. 17, No. 6, 919-27 (Sept. 16, 1960).

Reactions of the type $M^+ + XH = MH^+ + X$, where XH stands for hydrides of the fifth group elements, or deuterium and M^+ the respective ions or A^+, were studied. The rate constants, or their upper limits, are determined and compared with theoretical ones. Heats of formation of MH^+ ions are computed.

537.52 : 53

EFFICIENT TRITIUM LABELING WITH AN ELECTRIC DISCHARGE. See Abstr. 20369

ELECTRIC DISCHARGES

537

19628 INCREASE IN BREAKDOWN POTENTIAL OF A GAS ELECTRODELESS DISCHARGE IN THE PRESENCE A TRANSVERSE MAGNETIC FIELD AND THE CONCEPT OF EQUIVALENT PRESSURE.

S.N.Goswami.
Indian J. Phys., Vol. 33, No. 9, 405-6 (Sept., 1959).

A brief note pointing out the correspondence between the formulae derived for the "equivalent pressure" of a gaseous discharge in a transverse magnetic field by (1) Wehrli, Somerville, Huxley et al. and (2) Deb and Goswami. J.D.Crag

537

19629 PRODUCTION OF RESONANCE RADIATION IN DISCHARGE TUBES OF NON-CIRCULAR CROSS-SECTION.

M.A.Cayless.
Brit. J. appl. Phys., Vol. 11, No. 11, 492-8 (1960).

The theory of d.c. low-pressure metal-vapour rare-gas discharges is developed, for the cases of simple one-stage and simple two-stage ionization, in a manner which enables the perfo ance of a discharge in a tube of any given cross-sectional shape t be derived from that of an "equivalent" discharge in an "equivalen tube of circular cross-section. The latter can be obtained from a more detailed investigation of the discharge in a circular tube. It is shown that the discharges are capable of producing substantiall more resonance radiation per unit length at a given efficiency in tubes of a "flattened" cross-sectional shape, than in tubes of a circular cross-sectional shape, particularly when there is a narr or waisted, middle section. Multi-stage ionization ultimately restricts the extent to which this improvement can be carried to aspect ratios of about 3 : 1.

537.5

19630 POSSIBILITY OF DETERMINING THE POTENTIAL DISTRIBUTION OF A PLASMA FROM THE CHARACTERISTICS OF THE NOISE GENERATED IN A GASEOUS DISCHARGE.

A.A.Zaitsev, M.Ya.Vasil'eva and V.N.Mnev.
Zh. eksper. teor. Fiz., Vol. 36, No. 5, 1590-1 (May, 1959). In Russian. English translation in: Soviet Physics—JETP (New York Vol. 36(9), No. 5, 1130 (Nov., 1959).

In a hot-cathode discharge tube, the cathode/probe noise sign detected in a normal probe assembly is influenced by the probe sheath. As this sheath vanishes at plasma potential, the noise signal will increase. This property is used as a method of plottin plasma potential along a discharge tube. A.H.Gabri

537.

19631 ELECTRICAL DISCHARGES IN HIGH VACUUM.

G.Schmidt.
Acta phys. Hungar., Vol. 9, No. 1-2, 1-12 (1958).

Measurements were made of (a) the ratio of positive ions to electrons in such discharges, (b) the effect on the discharge of a magnetic field applied so as to produce a force on the cathode in the opposite direction to that of the electrostatic field, and (c) the current as a function of electric field and gap distance. It is concluded that neither the theory of Van de Graaff and Trump (Abstr. 1868 of 1947) nor that of Cranberg (Abstr. 5803 of 1952) explains the results, but that the discharge occurs in the gas liberated from the anode by electrons produced by field emission from the cathod J.Dutt

537.5

19632 PROPAGATION OF A DISCHARGE IN SINGLE CRYSTALS OF NaCl AND KCl.

A.V.Vorob'ev, G.A.Vorob'ev and M.A.Mel'nikov.
Fiz. tverdogo Tela, Vol. 2, No. 9, 2019-24 (Sept., 1960). In Russia

The paths are shown in microphotographs for crystals of thick ness 0.4 to 1.2 mm. It is deduced that the discharge is a single avalanche process. The crystallographic directions of the paths and the velocity of propagation depend on the field configuration, which can be explained by the effect of the positive ion space charg The propagation of the discharge is analogous to that over long distances in air. R.Berman

537.52 : 621.385.032.213.6

633 THE NORMAL CATHODE FALL FOR MONOCRYSTALLINE MATERIALS.

Ahsmann and Z.v.Gelder.
Vol. 15, 226-33 (May-June, 1960). In French and German.

Cathode fall data for the (100), (110), (111) faces of Ge, Si, n neon at 40 mm Hg are given. The temperature coefficient e potential fall is greater than it is for polycrystalline material. A.H.W.Beck

537.52

634 ELECTRIC STRENGTH OF METHANE AND DEUTEROMETHANE. J.C.Devins and R.W.Crowe.

em. Phys., Vol. 33, No. 5, 1578-9 (Nov., 1960).

Data on the sparking potentials of methane and deuteromethane ate that vibrational and rotational losses are not important in lectrical breakdown of hydrocarbon gases. G.I.W.Llewelyn

537.52 : 621.387

9635 "PRIZE": A PRE-IONIZED "THETA" PINCH.

R.D.Medford, A.L.T.Powell, J.D.Herbert, Pottinger and J.K.Wright.
ure (London), Vol. 186, 706-7 (May 28, 1960).

A system is described in which a fast axial pinch is used to vide pre-ionization for a "Theta" pinch. The two circuits are chronized by using a single explosive detonator to close switches oth. Streak photographs show that the pre-ionization effectively oves the trapped field in the first half-cycle. A.H.Gabriel

537.52

19636 PERIODIC MAGNETIC FIELD FLUCTUATIONS IN THE SCEPTRE DISCHARGE. N.L.Allen.

ure (London), Vol. 187, 279-82 (July 23, 1960).

Search coils inserted in the plasma of a 140 kA, 1.4 μ Hg terium discharge, with an initial stabilizing field of 1000 G, ect fluctuations having a frequency of about 20 kc/s and an plitude of about 20% of the mean field. Comparison of signals m coils spaced axially, and on opposite sides of the discharge, gest that there may be a helical disturbance propagated at × 10^6 cm/sec along the discharge axis in the direction of rent flow. R.S.Pease

537.52

19637 NEGATIVE SECTIONS OF MOVING STRIATIONS.

J.R.M.Coulter.
Electronics and Control, Vol. 9, No. 1, 41-61 (July, 1960).

An experimental investigation of moving striations in neon scharges at pressures (p) from 2 to 50 mm Hg was carried out rotating mirror photography. Supplementary photoelectric asurements were also made. The appearance of the discharges described in detail. Particular attention is given to the negative d of the column, where an increase in striation frequency usually ccurred at a distance from the anode determined by current and essure. The behaviour of this "branched" section was found to independent of the position of the anode, and its length decreased en either the current or pressure was increased. The velocity the waves varied as $p^{-1/2}$ in the unbranched part of the column d was only slightly dependent on anode-cathode spacing except en the latter was small. In the branched region the striations avelled more quickly and the velocity varied in a more complicated y with pressure. Moving striations disappeared from the column th large currents, but periodic fluctuations still persisted in the ode glow. The head of the column, when viewed without time solution, showed apparently stationary striae decreasing in disnctness towards the anode, but mirror and photoelectric measureents showed that the striae were definitely oscillatory. The pearance here was similar to that which would result if an unmped wave moving towards the cathode were superposed on a mped wave travelling in the opposite direction.

537.52

19638 THE ENERGIES OF POSITIVE IONS AT THE CATHODE OF A MERCURY GLOW DISCHARGE.

Bădărău and M.Hagiescu-Miriște.
ev. de Physique (Bucarest), Vol. 4, No. 4, 445-8 (1959). In German.

Experiments were made on the ion energies by using a shielded athode. Pressures varied from 0.04 to 0.24 mm Hg. Energy istribution data are shown graphically. J.D.Craggs

537.52

19639 SOME PROBLEMS REGARDING THE PHENOMENA OCCURRING AT THE CATHODE OF THE GLOW DISCHARGE. E.Badareu and I.Popescu.

Rev. de Physique (Bucarest), Vol. 5, No. 1, 41-82 (1960).

Reviews the results of experimental and theoretical investigations of glow discharges (mainly in A and other inert gases) carried out over the last two years in the authors' laboratory. The importance of the effect of charge-exchange on the motion of ions is stressed; values of cross-sections for charge exchange obtained by several different methods are compared. The results of electrical and spectroscopic measurements on abnormal glow discharges with single and double cathodes are given, and the general features of the mechanism of these discharges discussed. Well related to other work in this field with 120 references. J.Dutton

537.52

19640 ELIMINATION OF A GLOW DISCHARGE IN AN INDUCTION-HEATED VACUUM FURNACE. J.P.Burden.

Nature (London), Vol. 188, 221-2 (Oct. 15, 1960).

High frequency electrical breakdown of gas in induction-heated vacuum furnaces is often obtained. Experiments are described which attempt to reduce this effect. Addition of an inert gas produced an improvement but mercury vapour traps, short generator leads and grounding of the furnace cooling water produced no significant effect. Appreciable improvements apparently due to field reduction were obtained by hanging unconnected copper wires freely in the coolant. The final solution achieved utilizes silver plating, in strips, of the furnace water cooling jacket. With this arrangement, no discharges were observed even with full generator output (10 kV amp at 350 kc/s). H.Edels

537.52 : 621.316.722 : 621.387

19641 NOTES ON THE DESIGN OF GLOW DISCHARGE VOLTAGE STABILIZERS FOR PHOTOMULTIPLIER TUBE POWER SUPPLIES. L.K.Neher.

Nuclear Instrum. and Methods, Vol. 5, No.2, 95-100 (Aug., 1959).

A series of high stability neon glow discharge tubes (OG3/85A2) was used to stabilize 1685 volts for the dynode resistance divider of a photomultiplier tube to an accuracy of ±0.2%. The limit of stability and the ageing phenomena for the tube operating at reduced currents are discussed but not understood.

537.52

19642 A MATHEMATICAL MODEL FOR ARC COLUMNS WITH CYLINDRICAL SYMMETRY. G.Schmitz and J.Uhlenbusch.

Z. Phys., Vol. 159, No. 5, 554-62 (1960). In German.

A theoretical paper dealing with the solution of the Elenbaas-Heller energy-balance equation, on the basis of certain assumptions. J.D.Craggs

537.52 : 621.387

19643 EXCITATION IN A TRANSIENT ARC DISCHARGE.

A.M.Howatson.
J. Electronics and Control, Vol. 8, No. 6, 441-7 (June, 1960).

The intensity ratio of two copper emission lines was measured as a function of time for a transient arc in free air, using two photomultipliers simultaneously. The results are compatible with the thermal nature of the high-pressure arc, but indicate that for temperature measurement the usual assumption of Boltzmann populations may not be sufficient in an unsteady discharge of this type.

537.52

19644 DETERMINATION OF STREAMING VELOCITY AND THE FLOW OF HEAT AND MASS IN HIGH-CURRENT ARCS. T.B.Reed.

J. appl. Phys., Vol. 31, No. 11, 2048-52 (Nov., 1960).

Arc plasma streaming velocities were calculated from previously unpublished experimental data obtained by Olsen on total distributions at the anodes in 100 to 300 A argon and helium arcs. The dynamic streaming component of pressure was calculated by subtracting the magnetic component (due to the self-magnetic field of the arc) from this total pressure. Arc temperatures also measured by Olsen were then used to calculate densities and heat contents of the plasma, and these were used with the streaming pressure to calculate velocities and mass and heat flow distributions. These in turn were integrated to give total mass and heat flows. The results compare reasonably with other measurements and estimates in the literature. Peak velocities range from 16 000 to

60 000 cm/sec, mass flows from 0.04 to 0.23 g/sec. The plasma heat flow distribution shows a close similarity in shape to values of heat transfer intensity at the anode measured by Nestor. A comparison of the total heat flow in the plasma to the total heat transfer due to streaming at a series of currents show heat transfer proportional to $(\text{heat flow})^{0.62}$ which agrees with correlations used for heat transfer from gases and flames. A simplified model of arc pumping is presented which suggests that heat and mass flow should increase as $(\text{current})^{3/2}$. A simplified analogue experiment in mercury is described which illustrates graphically the streaming caused by a divergent current path in a conductor.

537.52

19645 STEPWISE ABLATION AND HEAT TRANSFER IN COLD-CATHODE ARCS.

A.von Engel and K.W.Arnold.

Nature (London), Vol. 187, 1101-2 (Sept. 24, 1960).

Describes a new model for cold-cathode arcs (cathode vapour emission mechanism) in which ablation of the cathode takes place by a step-by-step process. Lattice atoms may move through various positions until a final position is reached corresponding to an energy close to the boundary value and from which escape takes place. J.D.Craggs

537.52

19646 ON THE CHANGE OF EXCITATION CONDITIONS IN A D.C. ARC WITH THE AMOUNT OF [ELECTRODE] MATERIAL PRESENT IN THE DISCHARGE.

M.Segui-Cros.

Rev. Opt., Vol. 37, No. 5, 261-5 (May, 1958). In French.

Shows, particularly for certain Pd lines, how the relative intensities of spectral lines vary with time, over some 500 sec or more. There is a brief discussion. J.D.Craggs

537.52 : 536.55

TEMPERATURE MEASUREMENTS ON A LUMINOUS ARC DISCHARGE. See Abstr. 19520

537.52 : 621.387

19647 HARMONICS FROM A MICROWAVE GAS DISCHARGE.

N.R.Bierrum and D.Walsh.

J. Electronics and Control, Vol. 8, No. 2, 81-90 (Feb., 1960).

Harmonic power from a 10 cm wavelength glow discharge in neon was detected down to 6 mm wavelength (18th harmonic). The fundamental power was fed from the waveguide to a coaxial line terminated by the discharge tube. A second smaller waveguide was coupled to the coaxial line to extract the harmonic power. With careful matching at each wavelength, the conversion loss appeared to fall off by only 3-4 dB per harmonic after an initial drop of 35 dB to the third harmonic (lowest harmonic measured). A typical conversion loss from 10 cm to 8 mm (12th harmonic, was 63 dB, e.g. 20 kW input, 10 mW output. In general the output power increased with input power until arcing in the mount spoiled the measurement. A pressure range of 5-39 mm Hg was used.

537.52

19648 RADIO-FREQUENCY DISCHARGES IN MAGNETIC FIELDS.

F.Bisi and B.De Michelis.

Nuovo Cimento, Vol. 17, No. 3, 343-54 (Aug. 1, 1960).

Measurements on radiofrequency discharges in argon were made by using a magnetic field normal to the r.f. electric field. The power absorbed by the discharge was determined as a function of the pressure inside the chamber and the magnetic fields: different curves were obtained by increasing or decreasing the pressure. Different geometrical arrangements were used. The qualitative behaviour of the discharge is interpreted by using an average electron picture.

537.52

19649 ON HIGH-FREQUENCY DISCHARGES IN CONSTANT MAGNETIC FIELDS.

H.Schlüter.

Z. Naturforsch., Vol. 15a, No. 8, 744-5 (Aug., 1960). In German.

A brief note discussing breakdown voltages, etc., and discharge resistance for a high frequency (4-15 Mc/s) discharge in hydrogen or deuterium in a magnetic field (0-600 G). Gas pressures were from 0.1 to 0.6 mm Hg. J.D.Craggs

537.52

19650 INVESTIGATION OF FAST ELECTRONS IN POWERFUL PULSED DISCHARGES.

N.G.Koval'skii, I.M.Podgornÿi and M.M.Stepanenko.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1438-45 (1960). In Russian.

The properties of the fast electrons (50-300 keV) which pro hard X-rays in powerful pulsed discharges were investigated. dependences of the peak energy of the electron spectrum on the intitial pressure and initial voltage were derived. The effect of external longitudinal magnetic field on electron energy was studi The experiments were carried out in hydrogen, deuterium and i the inert gases.

537.52

PHOTOGRAPHY OF FAST ELECTRICAL DISCHARGES. Abstr. 19463

PLASMA

537.56 : 537

ION AND PLASMA SOURCES. See Abstr. 19769

537.56 : 53

A COMPILATION OF SOME RATES AND CROSS SECTIONS IN FULLY IONIZED PLASMAS, OF INTEREST IN CONTROLLE THERMONUCLEAR RESEARCH. See Abstr. 17638

537.56 : 53

FUSION EXPERIMENTS IN DEUTERIUM PLASMA. See Abstr. 17645

53

19651 EQUATIONS OF MAGNETO-PLASMA DYNAMICS.

A.I.Gubanov and Yu.P.Lun'kin.

Zh. tekh. Fiz., Vol. 30, No. 9, 1046-52 (Sept., 1960). In Russian.

Motion and heat transfer equations are obtained for a plasm a magnetic field for arbitrary values of $\omega\tau$ (ω = Larmor frequenc τ = time of free path of charged particles). The equations are expressed in terms of formulated hydrodynamic velocity compon heat flow and temperature gradient in a special co-ordinate syste where magnetic field is directed along one of the axes, as well in arbitrary cartesian co-ordinate system. The equations are analogous to those used in magnetohydrodynamics, so that they can b solved by methods used in the theory of viscous fluids.
J.K.Skwirzyns

537

19652 COUETTE FLOW IN MAGNETO-PLASMA DYNAMICS

A.I.Gubanov and Yu.P.Lun'kin.

Zh. tekh. Fiz., Vol. 30, No. 9, 1053-60 (Sept., 1960). In Russian.

The equations of motion of a viscous plasma in a magnetic field for arbitrary $\omega\tau$ (see preceding abstract) are solved in a simple case of Couette flow between 2 parallel infinite plates, one of which moves parallel to itself. Three cases are considered: magnetic field parallel and perpendicular to the plates and an arbitrary direction of magnetic field. Several peculiarities of the motion are obtained which do not normally ensue from magnetohydrodynamics (where $\omega\tau \ll 1$); thus, for example, there exists a component of plasma velocity perpendicular to the direction of pla velocity; magnetic field parallel to the direction of plate velocity causes a decrease of viscous motion. J.K.Skwirzyns

537.

19653 PLASMA ACCELERATION IN A COAXIAL SYSTEM.

A.I.Morozov and L.S.Solov'ev.

Zh. tekh. Fiz., Vol. 30, No. 9, 1104-8 (Sept., 1960). In Russian.

Using a hydrodynamic approximation, equilibrium configurati are found of a plasma clot accelerated in a coaxial system (i.e. between two cylindrical coaxial conductors, with an azimuthal magnetic field). It is shown that, for assumed ideal conductivity, thes configurations are not stable. J.K.Skwirzyns

537.

19654 CONTAINMENT OF POSITRONS IN A MIRROR MACHINE.

G.Gibson, W.C.Jordan and E.J.Lauer.

Phys. Rev. Letters, Vol. 5, No. 4, 141-4 (Aug. 15, 1960).

Containment times of up to 10 sec were obtained for trapped densities of about 10^4 cm^{-3} of positrons using noble gases as scatterers. The mirrors are biased and it is observed that most of th trapped component escapes via the weaker mirror. This indicates that multiple small-angle scattering is the dominant effect and tha the particles behave adiabatically. The experimental containment times agree well with times calculated from gas scattering theory ted for the effects of energy degradation of the β-spectrum e energy resolution of the detection system. For low scatter- s pressures (10^{-7} mm Hg) additional corrections are required diation effects (Abstr. 7197 of 1960). J.W.Sturgess

537.56

55 EXPERIMENTS ON THE GROWTH RATE OF SURFACE INSTABILITIES IN A LINEAR PINCHED DISCHARGE.

urzon, A.Folkierski, R.Latham and J.A.Nation.
Roy. Soc. A, Vol. 257, 386-401 (Sept. 20, 1960).

hotographic observations on the growth of surface instabilities near pinched discharge are presented, and numerical results growth rates are deduced from them. These are discussed eference to the various theoretical studies made. It is shown he Rayleigh—Taylor type of instability is likely to be the nant process and an attempt is made to compare the observed h rates with those predicted.

537.56

9656 EQUATION OF STATE OF HIGH TEMPERATURE PLASMA. T.Morita.

r. theor. Phys., Vol. 22, No. 6, 757-74 (Dec., 1959).

It is generally accepted that the equation of state of the Debye Hückel theory originally developed for strong electrolytes ng on classical statistical mechanics, is applicable to high- erature plasmas in thermal equilibrium. However, if classical stical mechanics were applied to fully ionized plasmas, the tion function would diverge because of the short-range attrac- between a pair of positive and negative charges, and there is a t whether the contribution of the infinite attraction may not some the contribution of the Debye—Hückel term. Here the tion of state of high-temperature plasmas is investigated in ns of quantum mechanics; it is shown that the Debye--Hückel oximation applies to plasmas of low density, of the order -10^{17} or so, at high temperatures at which $\lambda_e < \sim \alpha_0/Z$, where e de Broglie wavelength of an electron and α_0 the Bohr radius. result is obtained by reducing the problem to that of a suitable sical gas and confirming that the contribution of the watermelon ns — which is considered as the leading correction to the ye—Hückel approximation — is negligible compared with that e ring terms considered in the Debye—Hüchel approximation.

537.56

19657 ON THE SOLUTION OF THE FOKKER--PLANCK EQUATION FOR A PLASMA. M.Dràganu.

. Acad. Sci. (Paris), Vol. 251, No. 4, 518-20 (July 25, 1960).
rench.

The equation is solved by the use of standard expansions in erical harmonics. The results generalize those of Rosenbluth, cdonald and Judd, (Abstr. 8462 of 1957) to the case of no axial nmetry. H.N.V.Temperley

537.56

19658 AN EXPERIMENTAL STUDY OF THE LINEAR PINCH STABILITY. T.Sundström and S.Svennerstedt.

clear Instrum. and Methods, Vol. 4, No. 4, 213-20 (May, 1959).

The time to the first bounce of the dynamic pinch has been asured and compared with the formula derived by Rosenbluth. e theoretical dependence on gas pressure and electric field ength is verified. A coil system is described which has been used detect kink instabilities. When an axial magnetic field of sufficient ength has been applied, it has become impossible to detect the k instabilities which are shown to destroy the pinch in zero and oderate magnetic fields. Stability observations have been carried er several periods of the discharge. This revealed that the plasma rforms a contraction and seems to be stable in the subsequent riods also. Finally an investigation has been made of the pressure pendence of the electro-mechanical oscillation which is performed the plasma sheath before reaching equilibrium where the axial d azimuthal magnetic fields balance.

537.56

19659 REPORT ON LINEAR PINCH DEVICES.

R.Latham and J.A.Nation.
uclear Instrum. and Methods, Vol. 4, No. 5, 261-72 (June, 1959).

This report deals with various aspects of the linear pinch as possible source of thermonuclear power. The first section gives very approximate assessment of the unstabilized linear pinch, and oints out the severe practical difficulties of obtaining sufficient emperature and duration on present information. As many experiments have been done using the stabilized linear pinch, the stabilization problem is discussed and various proposed geometrical arrangements are briefly described. A summary is given of the published information on stability, mechanism of neutron production, temperatures achieved, and energy losses. Brief conclusions are drawn as to the role of the linear pinch in thermonuclear work.

537.56

19660 BRIEF REVIEW OF THE TOROIDAL STABILISED PINCH. R.J.Bickerton.

Nuclear Instrum. and Methods, Vol. 4, No. 5, 273-8 (June, 1959).

This report gives a short discussion of the stabilized toroidal pinch approach. Stability conditions and heating mechanisms are briefly summarized. A survey is given of experimental setups and results obtained with these.

537.56

19661 REMARKS ON THE STELLARATOR-SCHEME. L.Biermann.

Nuclear Instrum. and Methods, Vol. 4, No. 5, 279-81 (June, 1959).

Some points of interest in connection with devices of the Stellarator type are briefly discussed. Especially some difficulties are pointed out that may be caused by the use of longitudinal magnetic fields for ohmic heating.

537.56

19662 MAGNETIC MIRROR MACHINES. I. RÉSUMÉ OF THE STATE OF THE PROBLEM AND AN OUTLINE OF A PROGRAMME OF RESEARCH.

M.Bineau, T.Consoli, P.Hubert, F.Prévot, P.Ricateau and A.Samain.
Nuclear Instrum. and Methods, Vol. 4, No. 5, 282-9 (June, 1959).
In French.

This report gives a brief summary of the present knowledge of magnetic mirror machines, from both theoretical and experimental points of view. An attempt is also made to point out some lines of approach along which progress could be expected. A more extensive treatise on the same subject is given in part II (see following abstract).

536.56

19663 MAGNETIC MIRROR MACHINES. II.

M.Bineau, T.Consoli, C.Maisonnier, F.Prevot and P.Ricateau.
Nuclear Instrum. and Methods, Vol. 4, No. 5, 290-321 (June, 1959).
In French.

Summarizes the present knowledge of magnetic mirror machines not using compression. Compiled to establish a working programme, it gives detailed comparisons between differential lines of approach. A critical survey of experimental and theoretical results is attempted. A first part deals with confinement and stability problems in mirror machine geometries, while the second is devoted to injection of particles. In the third part, different types of mirror machine devices are briefly described, together with a discussion of experimental results.

537.56

19664 NOTES ON FAST MAGNETIC COMPRESSION OF PLASMAS. H.L.Jordan, H.Kever and K.Schindler.

Nuclear Instrum. and Methods, Vol. 4, No. 5, 322-6 (June, 1959).

In the first and main part of the report brief summaries are given of experimental work carried out at different laboratories on fast magnetic compression of plasmas. At the end, a short survey is presented of the theoretical work in this field.

537.56

19665 NOTES ON SOME THEORETICAL INVESTIGATIONS OF THE PHYSICS OF HIGH TEMPERATURE PLASMAS.

R.Lüst.
Nuclear Instrum. and Methods, Vol. 4, No. 5, 247-8 (June, 1959).

A brief survey is given of those 1958 Geneva papers devoted to the theoretical aspects of high temperature plasma physics.

537.56

19666 CONFINEMENT OF PLASMA BY RADIO-FREQUENCY ELECTRO-MAGNETIC FIELDS.

C.M.Braams, W.J.Schrader and J.C.Terlouw.
Nuclear Instrum. and Methods, Vol. 4, No. 5, 327-3 (June, 1959).

A review is given of proposed methods for confinement of plasma by radio-frequency electro-magnetic fields. Forces on charged particles in r.f. fields, the pressure balance, frequency limitations, the power balance of the plasma, and external power loss are discussed. Briefly mentioned are confinement in combined d.c. and r.f. fields and other confinement schemes using alternating fields.

537.56

19667 CONFINEMENT AND ENERGY BALANCE IN A ROTATING PLASMA. B.Lehnert.

Ark. Fys., Vol. 17, Paper 11, 177-8 (1960).

A short note giving some results of a treatment of plasma confinement in a system where particles are completely trapped by a magnetic field configuration and the centrifugal force acting on the particles. C.G.Morgan

537.56

19668 BEHAVIOR OF THE POSITIVE COLUMN IN A MAGNETIC FIELD.

C.Ekman, F.C.Hoh and B.Lehnert.

Phys. of Fluids, Vol. 3, No. 5, 833-4 (Sept.-Oct., 1960).

Reports further experimental studies of the electric fields due to plasma diffusion across the magnetic field. Concludes that the main phenomenon, a critical field above which the diffusion becomes anomalous, still occurs when the tube geometry is substantially altered. When copper discs, which should short out the ambipolar field, are inserted, the anomalous characteristics can be eliminated at low pressures. R.S.Pease

537.56 : 537.52

19669 ELECTRIC FIELD IN A MICROWAVE PLASMA AS A FUNCTION OF TIME. V.E.Mitsuk and M.D.Koz'minȳkh.

Zh. eksper. teor. Fiz., Vol. 36, No. 5, 1603-4 (May, 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 36(9), No. 5, 1139-40 (Nov., 1959).

The electric field in a plasma was measured by recording the Stark widths of the Balmer lines, using a photoelectric scanning attachment to a spectrometer. Recording was carried out in 0.1 μsec steps throughout a 2 μsec pulse of the 9400 Mc/s field. It was found that the field remained constant whereas the line intensity increased throughout the pulse. A.H.Gabriel

537.56

19670 RELATIVISTIC ELECTRON BEAM DEVICES FOR FUSION. J.G.Linhart and A.Schoch.

Nuclear Instrum. and Methods, Vol. 4, No. 5, 332-45 (June, 1959).

Equilibrium and stability of relativistic electron beams is studied with the view of evaluating the potentialities of such configurations for the confinement of hydrogen plasma. Tentative criteria for the use of these in a fusion reactor are derived. Particular attention is given to the heating of plasma and the proposed Astron-scheme.

537.56

19671 CONTINUOUS ELECTRIC CURRENT OBTAINED BY MEANS OF A JET OF IONIZED VAPOUR. S.Klein.

C.R. Acad. Sci. (Paris), Vol. 251, No. 5, 657-9 (Aug. 1, 1960). In French.

An effective separation of positive and negative charges has been obtained by means of ionized vapours of mercury or other substances. The vapours pass under pressure through a jet into an expansion chamber where a vacuum of 10^{-3} mm Hg is maintained. The fluid of molecules, ions and electrons passes electrodes, differential diffusion takes place and an e.m.f. (of about 10 V, for mercury) is created. The internal resistance depends upon the temperatures of the electrodes and is ~ 15 ohm. R.G.C.Arridge

537.56

19672 THE REALIZATION OF A STRONGLY IONIZED PLASMA OBTAINED BY A COMBINATION OF THE PINCH EFFECT AND A CUSP-SHAPED MAGNETIC FIELD.

J.P.Watteau.

C.R. Acad. Sci. (Paris), Vol. 251, No. 4, 532-4 (July 25, 1960). In French.

Pinch discharges of about 15 kA with rise times of about 10^{-6} sec were generated in a 35 cm × 10 cm bore quartz tube filled with deuterium, sometimes with 2-3% argon, at some tens of mm of Hg pressure. At maximum pinch, a 10 kjoule capacitor bank discharged into two 11 cm diameter coils separated by 8 cm, creating a cusp field rising to a maximum of 25 kG with a period of 10^{-5} sec. Photographs indicate a trapped hot plasma, with sharp, cusp-shaped boundaries. A sharp etch-mark on the quartz tube is a practical indication of the size of the leak at the cusp extremities. R.S.Pease

537.5

19673 DYNAMIC STABILIZATION OF A PLASMA RING. S.M.Osovets.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 311-16 (Aug., 1960). In Russian.

A method is proposed for dynamic stabilization of the long-wave instabilities of a plasma ring. The stability conditions are presented and the frequency range of the rapidly varying stabilizing magnetic fields is determined.

537

19674 THE STABILITY OF A THIN RING-SHAPED PLASMA CONDUCTOR IN A MAGNETIC FIELD. II.

Yu.V.Vandakurov.

Zh. tekh. Fiz., Vol. 30, No. 7, 781-9 (July 1960). In Russian.

For Pt I, see Abstr. 15015 of 1960. The plasma is treated as a compressible fluid carrying a surface current and (as in Pt I) surrounded by a toroidal conductor. The ratio of the two radii of the torus is treated as a small perturbation. The stability with respect to perturbation of wavelength comparable with the larger radius is studied. The effects of both internal and external longitudinal magnetic fields are treated. O.Penro

537.

19675 STATIONARY STATE OF A THIN PLASMA RING WIT FINITE CONDUCTIVITY. Yu.V.Vandakurov.

Zh. tekh. Fiz., Vol. 30, No. 9, 1134-6 (Sept., 1960). In Russian.

The drift velocity in a plasma can be compensated theoretical to zero. In practice, such compensation leads to a new type of dri which is discussed. J.K.Skwirzyns

537.56 : 550

19676 STABILITY OF A PLASMA IN THE FIELD OF A MAGNETIC DIPOLE. B.B.Kadomtsev and V.E.Rokotya

Dokl. Akad. Nauk SSSR, Vol. 133, No. 1, 68-70 (July 1, 1960). In Russian.

The energy principle of Bernstein, Frieman, Kruskal and Kulsrud (Abstr. 4159 of 1958) is used to study the stability of a low-pressure plasma outside a conducting sphere with a dipole at its centre. A stability criterion is derived, which shows that the plas is more stable than it would be if the sphere was an insulator. A comparison with experiment indicates that the plasma surrounding the earth is stable except near those lines of force which intersect the equatorial plane about 20 000 km out. O.Penros

537.5

19677 THE INSTABILITY OF A PLASMA WITH AN ANISOTROPIC DISTRIBUTION OF VELOCITIES IN A MAGNETIC FIELD. R.Z.Sagdeev and V.D.Shafranov.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 181-4 (July, 1960). In Russian.

It is shown that even at a weak temperature anisotropy

$$|T_{\perp} - T_{\parallel}| / T_{\perp} \ll 1$$

a plasma in a uniform magnetic field is unstable. The instability is due to the charges in the "tail" of the velocity distribution which are in cyclotron resonance with the perturbation wave.

537.5

19678 ELECTROMAGNETIC PROPERTIES OF A RELATIVISTIC PLASMA. V.P.Silin.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1577-83 (1960). In Russian.

Considers permittivity which takes into account spatial dispersion for an electron—ion plasma. Expressions are derived for the screening ranges and depth of the skin layer. Undamped and weakly damped plasma oscillations are considered.

537.5

19679 STRONG HYDROMAGNETIC DISTURBANCES IN A COLLISION-FREE PLASMA. J.W.Dungey.

Phil. Mag. (Eighth Ser.), Vol. 4, 585-93 (May, 1959).

An attempt is made to extend the exact pulse solutions found by Adlam and Allen (Abstr. 3263 of 1958) at zero temperature to finite temperatures and the heating of the plasma is studied. A linear treatment shows that the increase in the temperature is small except for very strong pulses. An approximate treatment of the gas pressure is found to be invalid for strong pulses at the experimental values of the initial temperature. Discussion of the ions which start with large thermal velocities shows that some of are likely to gain energy, but that their effect on the field may portant at the experimental values.

537.56

680 THE EFFECTIVE IONIZATION POTENTIAL OF ATOMS IN PLASMAS AND THE CONTRIBUTION FROM THE EST ATOMIC STATES TO THE CONTINUOUS EMISSION.

ınner.
ıys., Vol. 159, No. 3, 288-310 (1960). In German.

A detailed theoretical paper which deals, amongst other related ers, with the reduction of ionization potentials in plasmas, the ts of free electrons, the relevance of the effective ionization ntial to the application of Sahas' equation to a plasma and, very , with the calculation of emission continua. J.D.Craggs

537.56

9681 MAGNETIC BREMSSTRAHLUNG OF A BOUNDED PLASMA. K.N.Stepanov and V.I.Pakhomov.

ksper. teor. Fiz., Vol. 38, No. 5, 1564-8 (1960). In Russian.

Considers magnetic bremsstrahlung of a high-temperature ma located in a strong magnetic field.

537.56 : 523.16 : 551.5

9682 THE RADIATION EMITTED WITHIN IONIZED GAS IN THE PRESENCE OF A MAGNETIC FIELD.

awabata.
. Ionosphere Space Res. Japan, Vol. 12, No. 4, 428-36 (1958).

The intensity and the polarization of r.f. radiation emitted by onized gas in the presence of a magnetic field are investigated, ng into account the simultaneous interaction of electrons with surrounding ions. The calculation is made on the assumption the refractive index of the surrounding medium is unity. It is wn that Stokes' parameters of the radiation emitted by an zed gas can be obtained from the Fourier transformation of the relation functions between the various components of the electron ocity separated by a time interval τ. These correlation functions calculated using the Fokker—Planck equation and then Stokes' ameters of radiation are obtained.

537.56

19683 COULOMB SCATTERING OF CHARGES IN A STRONG MAGNETIC FIELD. Yu.N.Barabanenkov.

eksper. teor. Fiz., Vol. 38, No. 5, 1512-14 (1960). In Russian.

Considers Coulomb scattering of charges in a strong magnetic d when the impact parameter is much larger than the Larmor lius. The solution of the problem indicates that collisions cannot nge the plasma electron (ion) distribution function which is nmetric with respect to the transverse (relative to the magnetic ld) velocity component.

537.56

19684 SCATTERING OF RADIATION BY A PLASMA. F.I.Boley.

appl. Phys., Vol. 31, No. 9, 1692 (Sept., 1960).

Observations of the frequency dependence of the scattering of crowaves by the positive column of a Hg discharge (Abstr. 1612 1959) suggest that modification of previous theories may be cessary. R.S.Pease

537.56 : 538.56 : 621.391.812.624

SCATTERING OF RADIO WAVES BY A PLASMA. See str. 19931

537.56

19685 ON THE EFFECT OF THE IONIZATION OF MOLECULES ON THE PRESSURE VARIATION OF ELECTRON EMPERATURE IN THE PLASMA OF A GLOW DISCHARGE POSI-VE COLUMN. B.A.Engelke.

Phys., Vol. 159, No. 4, 373-7 (1960). In German.

A brief theoretical paper dealing with the current transport uation, which involves the electron temperature through the ambilar diffusion coefficient. J.D.Craggs

537.56 : 539.18

BROADENING AND SHIFT OF SPECTRUM LINES IN THE LASMA OF A GAS DISCHARGE. See Abstr. 17702

537.56

19686 PLASMA DIAGNOSTICS BY SPECTROSCOPICAL MEANS. H.Wulff.

ıclear Instrum. and Methods, Vol. 4, No. 5, 352-62 (June, 1959).

This paper is principally devoted to a discussion of possible applications of spectroscopy in the study of high temperature plasmas, the two main sections treating, respectively, measurements on spectral lines (intensity measurements, line profile determination, temperature determination) and continuous radiation (e.g. bremsstrahlung).

537.56

19687 METHODS OF SPECTROGRAPHIC DETERMINATION OF HIGH PLASMA TEMPERATURES. W.Rother.

Technik, Vol. 15, No. 8, 543-8 (Aug., 1960). In German.

A discussion on measurements of temperature from line intensities, line profiles and continuum intensities and their interrelation. C.G. Morgan

537.56

19688 A VISUALIZING METHOD OF ELECTRON TEMPERATURE AND PLASMA DENSITY.

H.Tamagawa and J.Fujita.
J. Phys. Soc. Japan, Vol. 14, No. 5, 678 (May, 1959).

Electron temperatures as well as plasma densities of a transient plasma are displayed directly on a cathode-ray tube. The principle is based on Langmuir's single probe method. The electron temperature is obtained by differentiating the logarithm of the probe current with respect to the probe potential, i.e.

$$\frac{e}{kT_e} = \frac{d}{dV}(\log I) = \frac{1}{I}\frac{dI}{dV} = \frac{1}{I}\frac{dI}{dt}\bigg/\frac{dV}{dt}$$

Then, if the probe potential is changed linearly with time, the electron temperature is given by the ratio of probe current to its time-derivative and is represented on a cathode-ray tube as the slopes of a straight line which starts from the origin, when the probe current is introduced to the y-axis, and the time-derivative to the x-axis. When the probe potential exceeds the space potential, electron current to the probe no longer increases with probe potential and saturation occurs, which results in abrupt discontinuity of dI/dt at the space potential. Once the electron temperature is determined, the plasma density is obtainable from the electron current density at the space potential, by

$$n = \frac{J_{es}}{e}\sqrt{\frac{2\pi m}{kT_e}}$$

537.56

19689 MEASUREMENTS OF TEMPERATURES AND DENSITIES IN SHOCK-HEATED HYDROGEN AND HELIUM PLASMAS. W.Wiese, H.F.Berg and H.R.Griem.

Phys. Rev., Vol. 120, No. 4, 1079-85 (Nov. 15, 1960).

Temperatures and densities in plasmas produced by strong magnetically driven shock waves in a "T tube" were measured spectroscopically. Local thermal equilibrium exists within the experimental accuracy for the conditions of this experiment. In both gases, the measured temperatures and densities are in disagreement with the values expected from the Rankine—Hugoniot relations, unless it is assumed that the conditions in the ambient gas are drastically affected by the initial discharge. Consistency between experiment and shock theory is achieved by considering magnetic pressure and dissociation and excitation of the ambient gas by u.v. radiation from the discharge.

537.56 : 530.16

GIANT CLUSTER EXPANSION THEORY AND ITS APPLICATION TO HIGH TEMPERATURE PLASMA. See Abstr. 18991

537.56

19690 PROBE MEASUREMENTS AT INTERMEDIATE PRESSURES.

V.M.Zakharova, Yu.M.Kagan, K.S.Mustafin and V.I.Perel'.
Zh. tekh., Fiz., Vol. 30, No. 4, 442-9 (April, 1960). In Russian.

The probe method of measuring plasma parameters is discussed for the case where the mean free path is smaller than the linear dimensions of the probe. A formula is derived for the electron current density at a cylindrical probe. This formula was used in conjunction with the double-probe method of Johnson and Malter (Abstr. 2478 of 1950) to determine plasma parameters for neon and argon at 1-20 mm Hg, and for mercury at 10 mm. Results obtained are summarized in tables and graphs. S.Chomet

537.56

19691 THE ELECTRICAL CONDUCTIVITY OF A PLASMA AT HIGH TEMPERATURE. H.Wilhelm.

Z. Naturforsch., Vol. 15a, No. 8, 749-51 (Aug., 1960). In German.

Brief theoretical discussion and development of work by Spitzer and others, in particular that of Schirmer. J.D.Craggs

537.56

19692 THE ABSORPTION COEFFICIENT OF A PLASMA AT RADIO FREQUENCIES. P.A.G.Scheuer.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 3, 231-41 (1960).

The theory of radiation due to free—free transitions by electrons in a plasma has been the subject of much work. Elwert has given an exact theory for binary electron-ion encounters but there has been doubt about the applicability of the formulae when an electron moves in the field of many ions at comparable distances; it is the aim of this paper to remove that doubt. The power radiated by an electron at frequency ν is proportional to the mean square amplitude of the Fourier component of frequency ν of its acceleration; as Cohen, Spitzer and Routly have pointed out in a different context, the correct value of this mean square amplitude is obtained by treating all encounters as independent binary encounters, provided that the collision parameters concerned are all less than the Debye length. In the radiation problem, the interest is only in frequencies greater than the plasma frequency, and the binary collisions contributing to such radiation all have collision parameters less than the Debye length. Consequently Elwert's treatment always gives the correct result, except at frequencies just above the plasma frequency. An explicit formula for the absorption coefficient of a plasma is worked out for a Maxwellian distribution of electron speeds. In the last section, the earlier considerations are applied to find the conditions necessary for radio-frequency radiation from encounters between electrons and concentrations of space charge.

537.56

19693 DIAMAGNETIC MOMENT OF GASEOUS PLASMAS MEASURED BY SPIN RESONANCE TECHNIQUE.

T.C.Marshall, R.A.Kawcyn and L.Goldstein.

Nature (London), Vol. 187, 584-5 (Aug. 13, 1960).

Nuclear and electron spin resonance techniques were used in a study of diamagnetic moments of plasmas in static and quasi-static magnetic fields. Measurements made in a low-current, low-pressure mercury discharge for fields up to 60G agree with results obtained by Langmuir probes. Measurements up to 5000G were carried out in a neon—argon mixture. The techniques are applicable to thermonuclear research. C.G.Morgan

537.56

19694 MAGNETIC SOUND IN A THREE-COMPONENT PLASMA. D.A.Frank-Kamenetskii.

Zh. tekn. Fiz., Vol. 30, No. 8, 893-8 (Aug., 1960). In Russian.

A plasma containing neutral atoms is treated by a three-fluid hydrodynamical approximation. The dispersion relation for wave propagation is obtained. At high frequencies the neutral atoms remain at rest, but at low frequencies they take part in the oscillations. In a weak or zero static magnetic field, there is a skin effect whose penetration depth is increased by frequent collisions. If the static field is strong, waves can propagate through the plasma and their damping is increased by frequent collisions. The role of non-linearities is also discussed briefly. O.Penrose

537.56

19695 MAGNETO-ACOUSTIC RESONANCE IN A PLASMA. D.A.Frank-Kamenetskii.

Zh. tekh. Fiz., Vol. 30, No. 8, 899-906 (Aug., 1960). In Russian.

It is suggested that a plasma could be heated by compressional waves excited by oscillatory variations in the containing magnetic field. The author considers that a sharp resonance (with small damping) favours the transfer of energy from generator to plasma, but that large damping favours the randomization of this energy within the plasma. O.Penrose

537.56

19696 BUILD-UP OF ION-ACOUSTIC OSCILLATIONS IN AN ANISOTROPIC PLASMA. A.V.Timofeev.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 397-9 (Aug., 1960). In Russian.

Oscillations of an anisotropic plasma located in a magnetic field are investigated for small values of $\beta = 8\pi nT_{\perp}/H^2$. It is found that in this case the ion-acoustic waves may be unstable.

537.56 : 538.

BUILD-UP OF MAGNETOHYDRODYNAMIC WAVES IN A PLASMA MOVING THROUGH AN IONIZED GAS. See Abstr. 1991

537.

19697 DETECTION OF ION OSCILLATIONS IN A PLASMA. M.D.Gabovich, L.L.Pasechnik and V.G.Yazeva.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1430-3 (1960). In Russian.

Ion oscillations were detected against the noise background of discharge plasma (charge concentration $\sim 10^{10}$ cm^{-3}). The results obtained can be explained by assuming that the probe selectively indicates oscillations with a wavelength which is approximately eq to the radius of an ionic layer surrounding the probe.

537.

19698 PLASMA RESONANCE IN A RADIO-FREQUENCY PROBE. K.Takayama, H.Ikegami and S.Miyazaki.

Phys. Rev. Letters, Vol. 5, No. 6, 238-40 (Sept. 15, 1960).

A resonant increase in d.c. component of the current to the probe is observed at the electron plasma frequency. This is discussed in terms of the interaction of the electron beam and the plasma. Measurements were made in mercury vapour at 10^{-4} mm Hg and constant discharge currents of between 4 and 9 m. C.G.Morg

537.56

19699 THE NON-LINEAR THEORY OF ELECTRON—ION PLASMA OSCILLATIONS. F.M.Nekrasov.

Zh. tekh., Fiz., Vol. 30, No. 7, 774-80 (July, 1960). In Russian.

Boltzmann's kinetic equation, appropriately modified, is used to investigate propagation of plasma waves of finite amplitude. A relation between amplitude and frequency is established and a critical amplitude is deduce beyond which oscillations cease to be stable. The ratio of the ionic and the electronic amplitudes is found to be small in the absence of a steady current. R.Eisenschit

537.

19700 NON LINEAR OSCILLATIONS IN A COLD PLASMA. E.A. Jackson.

Phys. of Fluids, Vol. 3, No. 5, 831-3 (Sept. - Oct., 1960).

A theoretical study of finite amplitude electrostatic oscillation in which the analysis based on the charged-sheet model (Dawson, Abstr. 4741 of 1959) is compared with that based on Eulerian equations (Sturrock, Abstr. 3198 of 1958). Discrepancies between published results are elucidated, and the result that there is no frequency shift is established. R.S.Peas

537.

19701 OSCILLATIONS IN PLASMA. II. S.Kojima, K.Kato, S.Hagiwara and R.Matsuzaki.

J. Phys. Soc. Japan, Vol. 14, No. 6, 821-7 (June, 1959).

As reported in Pt I (Abstr. 5989 of 1958), two or three plasma electron oscillations of slightly different frequencies were simultaneously generated in a hot cathode discharge. The filled gas was mercury vapour at pressures of order 1 μ. These oscillations were observed by a Yagi antenna set apart from the discharg tube as well as by a probe in it. In the discharges the primary electrons formed convergent and divergent beams. The oscillation of highest frequency was generated by the convergent beam in the central part of the tube. The oscillation of lowest frequency seeme to be generated near the wall of the tube by the divergent beam. Anothe oscillation having a middle frequency was generated at the peripher of the convergent beam.

537.

19702 EXCITATION OF OSCILLATIONS IN A [UNIFORM] PLASMA LAYER. M.Sumi.

J. Phys. Soc. Japan, Vol. 14, No. 8, 1093-7 (Aug., 1959).

A theory of excitation of standing waves by electron beam injection is presented. Various characteristics of the excited wav are investigated; in particular, discontinuous jumps of frequency and mode can be expected with the variation of electron density, layer thickness and beam voltage. The consequences of the theory are compared with experimental results.

537.56 : 621.385

19703 RADIO-FREQUENCY FORCED OSCILLATIONS IN NON-UNIFORM PLASMAS. R.B.R-Shersby-Harvie.

J. Electronics and Control, Vol. 8, No. 6, 421-9 (June, 1960).

A wave equation and associated equations is derived for periodic f ced oscillations in a collision free plasma. This set of equations i rather complicated and small signal approximations are derived, ch are applicable to plasma confinement problems. One approxi- ion is applied to the case of a fast E_0 travelling wave in plasma its behaviour is shown to be markedly different from the well- wn case of an E_0-wave at cut-off. Some difficulties with small nal theories are indicated and the need for further clarification nted out.

537.56

19704 THEORY OF SPATIALLY GROWING PLASMA WAVES.

M.Sumi.

Phys. Soc. Japan, Vol. 14, No. 5, 653-7 (May, 1959).

The linearized theory of spatially growing waves in a uniform asma is investigated in detail. By solving the dispersion relation, characteristics of excited waves are determined. Behaviour of growth-rate and the phase-velocity of the amplified wave are amined in connection with the frequency and various conditions of plasma and the directed beam. It is shown that the theory is in od agreement with some features of experimental results.

537.56

19705 THE PROPAGATION OF WAVES IN A PARTIALLY IONISED MEDIUM. A.Baglin.

R. Acad. Sci. (Paris), Vol. 251, No. 5, 684-5 (Aug. 1, 1960). In ench.

The propagation equation for plane waves is written down for e case when the magnetic field is longitudinal. For this case, the ansverse and longitudinal modes are uncoupled and can be studied parately, the speed of propagation and the damping being deter- ined. The damping is due partly to ion—ion, partly to ion—neutral ollisions. H.N.V.Temperley

ELECTRON EMISSION
ELECTRON BEAMS

537.533

19706 ON THE WORK FUNCTION OF Au AND Al DURING VACUUM—AIR TRANSITION.

G.Nadjakov, V.Vassilev, S.Balabanov.

C.R. Acad. Bulg. Sci., Vol. 11, No. 6, 461-4 (Nov. — Dec., 1958).

The changes of contact potential difference between evaporated films of gold and of aluminium and a reference gold electrode during transitions from vacuum to atmospheric conditions have been studied in order to follow corresponding changes in the work functions of the films. The work function of evaporated Au changes from 4.5 eV in vacuo to 4.8 eV after the admission of dry air; that of evaporated Al changes from 3.2 to 3.6 eV. These changes are irreversible and are ascribed to oxidation of the evaporated metal surface; smaller reversible changes (~0.03 eV) may be due to the adsorption and desorption of gases on to and from the surface.
C.H.B.Mee

537.533

19707 ON THE TEMPERATURE DEPENDENCE OF WORK FUNCTION OF SEMICONDUCTOR THERMOCATHODES.

B.V.Bondarenko.

Fiz. tverdogo Tela, Vol. 2, No. 9, 2140-51 (Sept., 1960). In Russian.

The work function, φ, of oxides of metals of Groups III and IV (Sc_2O_3, Y_2O_3, La_2O_3, TiO_2, ZrO_2, HfO_2) and tungstates of alkaline earth metals (Ba, Sr, Ca) of the Me_3WO_6 type was measured at various temperatures. High emissivity of the substances studied was attributed to the presence of a large proportion of free metals, formed as a result of activation at high (2200-2600°K) temperatures. With increasing magnitude of the lattice constant the temperature coefficient of φ increased with a corresponding decrease in the thermoelectron constant. The lattice constant of a given substance decreased with increasing concentration of excess metal, which indicated that the free metal was distributed uniformly throughout the crystals and not concentrated in the surface layers only. Good agreement between the experimentally determined temperature dependence of φ and the temperature dependence of the electrochemical potential, predicted from theoretical considerations, provided a basis for an explanation of several specific features of thermionic properties of semiconductor thermocathodes.
M.H.Sloboda

537.533

19708 CONSIDERATIONS ON THE SIGNIFICANCE OF THE TEMPERATURE COEFFICIENT OF THE WORK FUNCTION DETERMINED ON POLYCRYSTALLINE SURFACES (Ni). G.Comşa.

Stud. Cercetari Fiz., Vol. 10, No. 1, 145-62 (1959). In Roumanian.

The significance of the results obtained by the method of the displacement of the characteristics is discussed in a semi-empirical way, taking into account the different planes of the crystallites. L.Pincherle

537.533

19709 VARIATION WITH TEMPERATURE OF THE WORK FUNCTION OF NICKEL. G.Comşa.

Stud. Cercetari Fiz., Vol. 10, No. 1, 163-71 (1959). In Roumanian.

The temperature coefficient of the work function ψ of polycrystalline Ni was determined between 720° and 1025° K by the method of the displacement of the characteristics. The value obtained was $d\psi/dT = (-2.65 \pm 0.03)\ 10^{-5}$ eV/deg. It is claimed that all systematic errors were practically eliminated. At the pressure employed (1.2×10^{-9} torr) the effect of the residual gas was found to be negligible. L.Pincherle

537.533

19710 VARIATION WITH TEMPERATURE OF THE WORK FUNCTION OF MOLYBDENUM. B.Iosifescu.

Stud. Cercetari Fiz., Vol. 10, No. 1, 177-86 (1959). In Roumanian.

The variation with temperature of the work function ψ of polycrystalline Mo was determined between 700° and 1100° K. The variation is linear, and $d\psi/dT = (7.86 \pm 0.05)\ 10^{-5}$ eV/deg. It is claimed that the experimental accuracy was better by two orders of magnitude than that of previous determinations. The effect of the poisoning of the surface on $d\psi/dT$ was observed by increasing the air pressure in the apparatus. L.Pincherle

537.533

19711 ELECTRON EMISSION FROM A BARIUM COLD CATHODE AFTER A CURRENT PULSE IN A GAS.

N.V.Tatarinova and P.N.Chistyakov.

Izv. Akad. Nauk SSSR, Ser. Fiz., Vol. 24, No. 6, 635-9 (1960). In Russian.

"Cathode electronics Conference" Moscow, 1959 (see Abstr. 17022 of 1960). Earlier work on the behaviour of electron emission following a discharge is extended to the region of cosmic-ray energies. The fall-off of current with time after a pulse was measured for a number of cathodes; the curves fall within a moderately narrow band. The influence of cathode cleanliness and surface properties is also noted. A.E.I.Research Laboratory

537.533

19712 A POSSIBLE ORIGIN OF EXO-ELECTRON EMISSION IN PLASTICALLY DEFORMED METALS.

A.H.Meleka and W.Barr.

Nature (London), Vol. 187, 232-3 (July 16, 1960).

High resolution auto-radiographic film was placed on the surface of zinc single crystals after they had been plastically strained. Black lines were observed in the film, exactly corresponding with the slip lines. It is suggested that exo-electron emission likewise occurs at slip bands, probably at the points of emergence of dislocations. H.Mykura

537.533

19713 FIELD EMISSION THROUGH DIELECTRIC LAYERS.

R.Gomer.

Austral. J. Phys., Vol. 13, No. 2a, 391-401 (July, 1960).

Solid State Physics Conference (see Abstr. 17864 of 1960). Field emission experiments on the adsorption of inert gases on tungsten have shown the presence of stepwise multilayer adsorption. It is possible to obtain emission data through these layers. It turns out that after suitable corrections for the reduction in field by dielectric effects a thinning of the field emission barrier remains. This is attributed to the fact that individual inert gas atoms represent short-range but deep potential holes (as in ordinary scattering) and so make the barrier more transparent. It is possible to treat the effect quantitatively in two approximations. One is due to Fermi and yields scattering lengths. The other consists of neglecting electronic motion transverse to the barrier, thereby making the problem one-dimensional and results in potential well dimensions. It is possible to calculate theoretical Fermi lengths for various assumed well shapes and dimensions. This is done for square wells and used to compare the results of the two approximations, in terms of the effective nuclear charges required to produce matching of the experimental Fermi lengths with the experimental well dimensions. Reasonable values of Z result for neon, argon, krypton, and xenon. Since the zero of the potential wells lies above that of the tunnelling electrons these experiments represent in fact scattering of negative-energy electrons.

537.533

19714 NEW COLD CATHODE USING MAGNESIUM OXIDE.

T.Imai, Y.Mizushima and Y.Igarashi.

J. Phys. Soc. Japan, Vol. 14, No. 7, 979-80 (July, 1959).

A preliminary note on the characteristics of an MgO cathode employing the self-sustained emission effect first reported for MgO by Dobischek, Jacobs and Freely (Abstr. 7725 of 1953). The cathode is not self-starting and requires an external stimulus such as electron, photon or ion bombardment before emission is obtained.

C.H.B.Mee

537.533

19715 SOME ELECTRICAL AND SURFACE PROPERTIES OF SINTERED NICKEL MATRIX CATHODES. R.W.Fane.

Brit. J. appl. Phys., Vol. 11, No. 11, 513-16 (1960).

Measurements of the work function of nickel matrix cathodes yield values in the region of 1 eV. Schottky plots are found to agree with theory provided the cathode surface is polished. Deviations from the image law at low field strengths may be explained using patch theory with suitably chosen parameters. The results of surface field determinations indicate a very small degree of coverage of the nickel grains by alkaline earth metals or oxides.

537.533

19716 EMISSION PROPERTIES OF SILICON TREATED IN CAESIUM VAPOUR.

V.G.Bol'shov, L.V.Vasil'eva and G.N.Pautova.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1981-3 (Aug., 1960). In Russian.

It was previously shown (Abstr. 7139 of 1960) that the electron emission properties of germanium were affected by treatment in caesium vapour. The present paper shows analogous results with silicon treated in this way.

A.E.I.Research Laboratory

537.533

19717 AN EXPERIMENTAL INVESTIGATION OF THE AMPLITUDE DISTRIBUTION OF ELECTRICAL NOISE.

H.Rogenhagen and K.H.Simon.

Z. angew. Phys., Vol. 12, No. 9, 395-7 (Sept., 1960). In German.

Measurements were made with an oxide cathode tube. The noise spectrum was measured in detail and compared satisfactorily with that expected from statistical theory.

J.D.Craggs

537.533

19718 PHOTOELECTRIC EMISSION FROM SOLID LAYERS OF PINACYANOL AND PINACRYPTOL.

F.I.Vilesov and A.N.Terenin.

Dokl. Akad. Nauk SSSR, Vol. 134, No. 1, 71-3 (Sept. 1, 1960). In Russian.

Continuation of earlier research (Abstr. 17028 of 1960). The thin polycrystalline layers of pinacyanol and pinacryptol were obtained by precipitation from ethanolic solutions on to Ni disks. For pinacryptol, the distribution of photoelectrons by quantum energy values is, in general, similar to that observed with β-carotene (earlier paper), while completely different curves are obtained for pinacyanol.

F.Lachman

537.533

19719 SEMICONDUCTING PHOTO-EMITTERS.

A.H.Sommer.

Optica Acta, Vol. 7, No. 2, 121-7 (April, 1960).

In the visible range of the spectrum, the quantum efficiency of metallic photo-emitters is below 0.1 per cent because of low light absorption, energy loss of electrons by scattering and high work function. On the other hand, high efficiency can be obtained from some complex semiconducting materials which combine a small energy band gap with low electron affinity. Outstanding among these materials are the mono- and multi-alkali antimonides. Optical, electrical, photoelectrical and other properties of these emitters are described which permit the interpretation of their characteristics in terms of self-consistent band models. Following a brief mention of the two photoemitters Ag—O—Cs and Bi—Ag—O—Cs, all photocathodes of high quantum efficiency are compared with regard to their usefulness in various applications. It is shown that for al wavelengths below 8000 A the three-alkali cathode of the composition [Cs]Na_2KSb is superior to other materials.

537.5

19720 PHOTOELECTRIC MEASUREMENTS ON NICKEL AN NICKEL OXIDE FILMS.

J.S.Anderson and D.F.Klemperer.

Proc. Roy. Soc. A, Vol. 258, 350-76 (Oct. 25, 1960).

In order to gain a clearer understanding how molecular oxyge and hydrogen react with the surfaces of metals and metallic oxides the electronic work function was measured during the oxidation of evaporated nickel films and the reduction of nickel oxide with hydr gen. The measurements included changes in the spectral sensitivi of surfaces prepared under varied conditions, and in the photoelectric yield (at constant photon energy) during the admission of gas. Admission of oxygen to nickel films at 20°C resulted in several distinct effects. Lightly oxidized films (< 1 monolayer equivalent total uptake) gave composite spectral sensitivity curves. By using the Fowler equation in the form of a plot of frequency against (phot electric yield)$^{1/2}$, these were analysed in terms of two work functio which remained unaltered until the films were saturated with respe to the rapid chemisorption of oxygen. As further quantities of oxyg were absorbed, both work functions rose. When the films were sto in vacuo, the lower work function decreased, finally reaching a low value than that measured for clean nickel; at the same time the film recovered the capacity to adsorb oxygen. The process is regarded as identical with the known "thermal regeneration", namely, the ability of oxidized films to take up oxygen rapidly after they have been heated in vacuo at 200 to 400°C. Although the lower work function fell markedly as thermal regenation occurred, the higher work function did not fall below about 5.7 eV. It is considered that the observations point to two kinds of surface structure in the lightl oxidized films. The work function of 5.7 eV is assigned to areas thinly covered with the nickel oxide crystal lattice, while the lower work function is assigned to areas on which the oxide, as such, does not form. It is suggested that the initial interaction of oxygen with the surface is largely non-polar, and that nickel oxide only forms on certain areas as a result of migration, charge transfer and rearrangement. Those parts of the surface not covered with the nickel oxide crystal lattice undergo modification, as a result of penetration of oxygen into the surface layers of the metallic lattice. Photoemission from nickel oxide films (> 1000 A thick) was examined, and the interaction of hydrogen with these films was studied in detail. Changes in photoelectric yield show that there is some small degree of chemisorption at 20°C, and it is postulated that this represents formation of H_2^+ which either penetrates the nickel oxide lattice or occupies vacant cation sites in or near the surface. At higher temperatures the surface potential becomes increasingly negative as dissociative chemisorption takes place extensively by the mechanism already recognized. With the desorption of water and the continuation of reaction, nuclei of nickel form. The findings are in agreement with, but amplify, the accepted generalized model for oxidation and reduction processes.

537.533 : 539.2 : 537.311

19721 MEASUREMENTS ON MIXED ALKALI [METAL] PHOTO CATHODES.

G.Frischmuth-Hoffmann, P.Görlich, H.Hora, W.Heimann and H.Marseille.

Z. Naturforsch., Vol. 15a, No. 7, 648-50 (July, 1960). In German.

Results are given for the variation of electrical conductivity with temperature for a photocathode of the (Cs—Na—K)Sb type. The spectral response for the absorption and reflection of plane polarized light is also shown.

N.Murcot

537.533 : 621.38

19722 INFLUENCE OF THE POLARIZATION OF LIGHT ON THE EMISSION OF COMPOUND PHOTOCATHODES.

P.Gërlikh and Kh.Khora.

Izv. Akad. Nauk. SSSR, Ser. fiz., Vol. 24, No. 6, 698-704 (1960). In Russian.

"Cathode electronics Conference" Moscow, 1959 (see Abstr. 17022 of 1960). The influence of the angle of polarization of incident light is weaker for semiconducting cathodes than for metal ones. For some materials output is greatest when the electric vector is in the plane of incidence, whereas for others optimum output requires the electric vector to be perpendicular to this.

M urements are made for various cathodes and various angles of larization, and a partial explanation for their behaviour is ad aced. A.E.I. Research Laboratory

537.533 : 621.383.27.

723 STUDY AND DESIGN OF A PHOTOMULTIPLIER FOR THE NANOSECOND REGION. G.Pietri.

N ear Electronics Conference, Paris, 1958. Vol. I. (see Abstr. 12 9 of 1960) p. 57-65. In French.

The photomultiplier, (L.E.P. type 204) is designed to give a r output at the anode up to more than 300 mA. The current is between 10^6 and 10^9 and is obtained by the use of 14 dynodes, stage voltages up to 400, and a carefully designed electron- al system between the photo-cathode and the first dynode. The de structure is designed to have trajectory-compensating and sing effects, so that asynchronism is reduced to a minimum rise times between 2 and 3 × 10^{-9} sec are obtained.

W.G.Stripp

537.533 : 621.383.27

9724 MEASUREMENT OF THE SPEED OF RESPONSE OF THE L.E.P. TYPE 204 PHOTOMULTIPLIER.

Y oechlin.

N lear Electronics Conference, Paris, 1958. Vol. I. (see Abstr. 19 of 1960) p. 67-72. In French.

See also Abstr. of 1960. Pulse shapes were investigated, g an oscillating ball light source and a high-speed oscilloscope. expected rise times of about 2 × 10^{-9} sec were confirmed.

W.G.Stripp

537.533 : 621.317.39 : 621.383.27

19725 A FAST PHOTOMULTIPLIER AND COINCIDENCE SYSTEM FOR PRECISE TIME MEASUREMENTS.

A.Morton and R.M.Matheson.

clear Electronics Conference, Paris, 1958. Vol. I (see Abstr. 19 of 1960), p. 201-8.

In a new R.C.A. photomultiplier, electron path lengths between odes are made as nearly equal as possible and in each inter- ode space the electrons are accelerated by electrodes at entials around 3 kV, so that small differences of path length are de unimportant because of the high average velocity. A shield ound the collector reduces the displacement-current effect, and urved photocathode, in conjunction with relatively high potentials the lens elements, minimizes the effect of initial velocities. test the photomultiplier, a beam-deflection tube was used. lses were obtained from the anodes and the last dynodes of two otomultipliers and applied to the deflector plates. The rest sition of the beam is on a 45° radius of a screen, at the centre of ich is a small aperture. Pulses which are coincident after suitable plitude adjustment and delay, deflect the beam so that it crosses aperture and is detected by a photomultipler behind the screen. n-coincident pulses deflect the beam on a curved path which does t cross the aperture. The time distribution curve of the beam flection coincidence tube has a half-amplitude width of 5 × 10^{-10} sec. W.G.Stripp

537.533

19726 AN APPARATUS FOR THE MEASUREMENT OF THE LOCAL SENSITIVITY OF PHOTOMULTIPLIERS.

.Pietri and C.Arvin.

Phys. Radium, Vol. 19, Suppl. No. 12, 154A-159A (Dec., 1958). French.

A laboratory equipment specialy devised for a fast and easy easurement of this sensitivity is described. The apparatus named Marguerite-explorer" operates by reference to the light-scanning ttern, is entirely optico-mechanical, and is without any electronic mponents. It has been designed to be rugged, simple to manufac- re and use, and of low cost. Many photographs are shown of iformity tests, taken, at the photocathode itself as well as the ode of the photomultiplier tubes.

537.533 : 522.5

THE ACTUAL POSSIBILITIES OF ELECTRONIC PHOTO- RAPHY. See Abstr. 18591

537.533 : 522.5

SOME RESEARCH INTO THE GRADUAL DEVELOPMENT OF LECTRONIC PHOTOGRAPHY. See Abstr. 1859

537.533

19727 THE TWO COMPONENT SYSTEM ANTIMONY—RUBIDIUM AS A SECONDARY ELECTRON SOURCE.

V.Kanev.

C.R. Acad. Bulg. Sci., Vol. 11, No. 6, 457-60 (Nov.-Dec., 1958). In German.

Evaporated layers of antimony are subjected to rubidium vapour treatment and electrical resistance measurements are made. Two states of the layer corresponding to $RbSb_2$ and Rb_3Sb are found and with higher rubidium content an excess exists in equilibrium with Rb_3Sb. Addition of rubidium to antimony increases the relative number of slow electrons in secondary emission. An advantage over Sb—Cs surfaces lies in the smaller dark currents for Rb—Sb layers.

G.F.J.Garlick

537.533

19728 SECONDARY ELECTRON EMISSION DURING THE BOMBARDMENT OF A SODIUM LAYER BY ARGON IONS. U.A.Arifov and D.A.Tashkanova.

Izv. Akad. Nauk. SSSR, Ser. fiz., Vol. 24, No. 6, 664-7 (1960). In Russian.

"Cathode electronics Conference", Moscow, 1959 (see Abstr. 17022 of 1960). Sodium deposited in the form of a thin layer on tantalum was bombarded by argon ions and the volt-ampere characteristics of the resulting secondary emission found as a function of sodium layer thickness. Two groups of particles were observed (hard and soft spectra) and the variations of these are compared.

A.E.I. Research Laboratory

537.533

19729 SECONDARY ELECTRON EMISSION OF MgO CRYSTALS BOMBARDED BY RELATIVISTIC ELECTRONS.

M.A.Pomerantz, R.A.Shatas and W.C.Schieve.

J. appl. Phys., Vol. 31, No. 11, 2036-9 (Nov., 1960).

The yield of single crystals of MgO has been determined at a primary energy of 1.3 MeV, utilizing a modification of the "sandwich" technique developed earlier for investigating the secondary electron emission of metals at high primary energies. The value of δ for Al was measured concurrently under identical conditions. The accumulation of surface charges usually encountered with insulators is prevented by the bombardment-induced conductivity of MgO. The influence of multiple scattering and energy loss of the primary beam, as well as of δ-ray production, must be considered when the targets are relatively thick as in the present case. An empirical correction for normalizing the thick target measurements to thin target conditions was determined. The result is: $\delta_{MgO} = 0.09 \pm 0.02$ as compared with $\delta_{Al} = 0.023 \pm 0.003$.

537.533

19730 DEPENDENCE OF SECONDARY ELECTRON EMISSION FROM MgO SINGLE CRYSTALS ON ANGLE OF INCIDENCE. A.B.Laponsky and N.R.Whetten.

Phys. Rev., Vol. 120, No. 3, 801-6 (Nov. 1, 1960).

The influence was studied of the angle of incidence of primary electrons on the energy distribution and total yield of secondary electrons from MgO cleaved single crystals. Charging effects were minimized by using single pulse techniques. The relative number of low-energy secondary electrons decreases with increasing angles of incidence. The effect appears to be most marked at primary energies in the vicinity of the maximum of the yield curve. At lower and higher primary energies the dependence on angle of incidence diminishes. Under most conditions the total yield increases with increasing angles of incidence. The magnitude of the increase is influenced by the primary electron energy. At low energies a slight decrease in total yield with increasing incidence angles was observed. A dependence of the backscattered fraction of electrons on the angle of incidence of the primaries was observed at several primary electron energies. A number of maxima and minima occur superposed on the gross variation of total yield with angle of incidence. The angular positions of the maxima are insensitive to primary energy but show a dependence on the crystal orientation. Several models for accounting for the phenomena are discussed.

537.533

19731 USE OF A GASEOUS ION GUN FOR THE STUDY OF SECONDARY EMISSION FROM A STRAINED METAL SURFACE. R.Goutte and C.Guillaud.

J. Phys. Radium, Vol. 19, No. 11, 911-12 (Nov., 1958). In French.

Thin gold samples under tension were bombarded with argon or nitrogen ions, and the secondary electron emission coefficient γ determined as a function of the strain. An increase in γ of about 10% of the unstrained value was found at the point of fracture of the sample. Full details of the ion gun and of methods of measurement are given. C.H.B.Mee

537.533 : 621.385.2

19732 POTENTIAL DISTRIBUTION BETWEEN TWO PLANE EMITTING ELECTRODES. II. THERMIONIC ENGINES.

P.A.Lindsay and F.W.Parker.

J. Electronics and Control, Vol. 9, No. 2, 81-111 (Aug., 1960).

Gives expressions for the potential distribution between two plane parallel emitting electrodes, extending the work of Pt I (Abstr. 7152 of 1960). It is shown that all potential distributions can be represented by a two-parameter family of curves, the parameters being the ratio of the electrode temperatures $\theta = T_2/T_1$ and a constant A which depends on θ and on the potentials and work functions of the two electrodes (A reduces to the parameter of Pt I for $\theta = 1$). The results show rather clearly the relative influence of all these quantities on the position and depth of the potential minimum between the electrodes.

537.533 : 621.385.2

19733 TRANSIENT SPACE-CHARGE FLOW.

R.J.Lomax.

J. Electronics and Control, Vol. 9, No. 2, 127-40 (Aug., 1960).

The results of a numerical investigation of the flow of space-charge under non-steady state conditions in a parallel plane diode are described. These show how the steady state is set up from an initial state, or in the case where a virtual cathode is formed, how a quasi-steady state is established. Under retarding field conditions, oscillations are observed which are thought to be related to Barkhausen—Kurz oscillations.

537.533 : 533.5 : 621.385.1

INTERNATIONAL SYMPOSIUM ON RESIDUAL GAS IN ELECTRON TUBES AND IN SIMILAR HIGH-VACUUM SYSTEMS. See Abstr. 19224

537.533 : 621.385.2

19734 EFFECT OF MAGNETIC FIELDS ON THERMIONIC POWER GENERATORS.

A.Schock.

J. appl. Phys., Vol. 31, No. 11, 1978-87 (Nov., 1960).

It is demonstrated that the high currents present in large thermionic power generators produce magnetic fields which result in a considerable reduction of electron transmission and energy conversion efficiency. To overcome the adverse effect of the self-induced field, the report presents the concept of a magnetothermionic power generator, employing an externally produced magnetic field parallel to the current direction. Analysis indicates that this concept will permit efficient operation of large generators. In addition, by use of a modulated field coil current, it offers the possibility of the direct generation of alternating current, at a controlled frequency.

537.533 : 538.56

NEGATIVE ENERGY PROPAGATION BY SLOW WAVES. APPLICATION TO MICROWAVE TUBE THEORY. See Abstr. 19925

537.533

19735 CONSERVATION LAWS OF AN INTERACTING ELECTRON BEAM.

M.C.Pease.

J. appl. Phys., Vol. 31, No. 11, 2028-36 (Nov., 1960).

The linearized theory of electron beams interacting with a circuit is studied. Such systems may be considered as coupling the modes of, for example, the beam and the circuit. It has been found, previously, that if these modes are properly defined, then there is a conservation law which states the constancy of the total power in these individual modes, independent of the extent of coupling. In single-frequency beam-type devices, this conservation law is Chu's kinetic power theorem. In multiple-frequency parametric systems, it is the linearized Manley—Rowe relation. The problem of such an interpretation is to determine what is an appropriate modal description that will lead to a convenient and useful conservation law. To obtain a systematic means of finding such a representation, we observe that any linear homogeneous system with n degrees of freedom has n quadratic invariance. The kinetic power theorem and the linearized Manley—Rowe relation are examples of such quadratic invariances, which are distinguished from the others by being independent of certain of the parameters of the system. Methods are obtained for determining, from the differential equations of the system expressed in any appropriate variables, the quadratic invariance, if it exists, which is independent of a given parameter If the basis is now changed to one which diagonalizes this invarian then we will have determined a modal, or wave, description in terms of which the invariance becomes a kinetic power law, as it usually written. This method of analysis is illustrated by applicat to the infinite-plane parallel beam, the interaction of a longitudina thin beam with an incompletely coupled circuit, and the interactio a weakly constrained filamentary beam with a transverse-field circuit.

537.5

19736 ON THE MAGNETIC PERTURBATION OF AN ELECT BEAM.

S.Yamaguchi.

Indian J. Phys., Vol. 33, No. 12, 547-9 (Dec., 1959).

The spreading of an electron beam on passing through a magnetic field gradient is investigated by using the thin edge of a magnetized razor blade as a specimen in an electron diffraction camera. Gradients of about 10^6 G/cm are encountered. The observed spot splitting is attributed to the presence of irregularities in the edge of the blade leading to mutual repulsion of the polarize beams. A.E.I.Research Laborato

537.53

19737 ADIABATIC COLLAPSE OF A RELATIVISTIC ELECTRON BEAM.

T.F.Godlove and D.C.DePackh.

J. appl. Phys., Vol. 31, No. 11, 2016-24 (Nov., 1960).

Differential equations are derived and two computer solutions presented for the case of a relativistic electron beam injected into neutral gas. Processes included are ionization, scattering of electrons on atoms and ions, charge exchange, supply of neutrals to the beam by diffusion, and incoherent radiation by the electrons. A longitudinal electric field is assumed. The main restrictive assumptions are those of uniform densities and hydrodynamic stability Solutions are given for an 1100 A, 0.77 MeV, externally-focused beam injected into H_2 at pressures of 10^{-6} and 2×10^{-6} mm Hg. Th beam contracts from an initial radius of 1.73 cm to an equilibrium radius of 7×10^{-4} cm in 3 and 0.5 msec, respectively. It is found in these cases that neutrality of the beam does not occur until after the radiation-scattering equilibrium, which was first studied by Budker (1956), has occurred. Several difficulties connected with a neutralized beam are discussed. It is shown that a space-charge-limited beam of high phase-space density is the type most suitable for obtaining a small beam diameter in the shortest time. An approximate solution is derived which applies after a specified time near equilibrium and allows calculation of several parameters of interest without the necessity of computer integration.

537.53

19738 COMMENTS ON NECESSARY AND SUFFICIENT TRAJECTORY CONDITIONS FOR DENSE ELECTRON BEAMS.

W.M.Mueller.

J. Electronics and Control, Vol. 8, No. 2, 111-12 (Feb., 1960).

Corrects author's earlier paper (Abstr. 3802 of 1960), by showing that the conditions given there are not necessary, and provides a larger set of sufficient conditions. B.Meltze

537.533 : 621.385.632.

19739 ON THE NONCONSERVATION OF NOISE PARAMETER IN MULTIVELOCITY BEAMS.

J.Berghammer and S.Bloom.

J. appl. Phys., Vol. 31, No.3, 454-8 (March, 1960).

Macroscopic equations for conservation of charge, momentum, and energy, as derived from the Boltzmann equation, are applied to an electron stream having a velocity spread. For small velocity spreads, these equations are simple to treat. The noise parameters S and Π, which determine the minimum noise figure of a beam-type microwave tube, lose their invariance in the presence of velocity spread; they become functions of position. The changes of S and Π are such as to lower the minimum noise figure. These results are in agreement with a detailed numerical solution of the Boltzmann equation as previously reported by others.

537.533 : 621.385.83

19740 THE STABILITY OF COMPUTATION OF THE PIERCE—CAUCHY PROBLEM.

B.Meltzer.

J. Electronics and Control, Vol. 8, No. 6, 449-53 (June, 1960).

Limits are found analytically for rate of growth of error in computation — by "marching" methods — of solutions of the

-difference form of Laplace's equation in two dimensions, Cauchy boundary conditions. A series of alternative non- hing methods are proposed, which should be stable.

537.533 : 621.385.833

741 COMPARATIVE TEST OF TARGETS FOR OBSERVING DENSE ELECTRON BEAMS. L.A.Harris.

sci. Instrum., Vol. 31, No. 11, 1242-4 (Nov., 1960).

537.533

742 NUMERICAL INTEGRATION OF THE PARAXIAL RAY EQUATION IN ELECTRON OPTICS.

peyre and M.Laudet.

Acad. Sci. (Paris), Vol. 251, No. 5, 679-81 (Aug 1. 1960). In ch.

Derives two forms of the paraxial ray equation in different form, ble for use by digital computation. An example of a calculated ctory is given. A.E.I. Research Laboratory

537.533 : 621.385.632.1

9743 ELECTRON SHEET BEAM FOCUSING WITH TAPE LADDER LINES. W.E.Waters.

ppl. Phys., Vol. 31, No. 10, 1814-20 (Oct., 1960).

The d.c. properties of a periodic focusing system consisting of rallel pair of ladder lines, together with focusing plates parallel e lines, are calculated. First, Laplace's equation is solved in pproximate way; following this, the paraxial-ray equation for an tron sheet beam, injected into the system halfway between the er lines, is solved for perveance, plasma frequency, beam ness and average beam potential. Finally, a numerical example resented and discussed.

537.533 : 621.385.833

9744 BALANCED ACCELERATION AND DEFLECTION ELECTROSTATIC FOCUSING. P.A.Sturrock.

Electronics and Control, Vol. 8, No. 4, 267-72 (April, 1960).

Periodic focusing systems normally have the following property: the strength of the focusing field is increased from zero, the tem is initially stable but subsequently passes through alternate ds of stability and instability, of which the former are normally narrower. In consequence, operation of a given system must ally by restricted to the first band. A suitable combination of eleration focusing and deflection focusing leads to a model for a iodic electrostatic focusing system which is free from instabili- . Convenient electrode structures are shown which will approxi- te the required field; the resulting system should have only narrow ds of instability. Such structures are similar to the slalom figuration with the important difference that the beam travels on side only of the central electrodes. This scheme also has the lowing characteristics which should make it suitable for incorporan in a tape-helix travelling-wave tube: the beam velocity varies such a way that electrons spend most time between the central ctrodes, and the beam thickness varies in such a way that the am is thinnest where it passes the central electrodes.

537.533

19745 DETERMINATION OF INDUCTION AND ITS DERIVATIVES ON THE AXIS OF MAGNETIC ELECTRON NSES. P.Durandeau, B.Fagot, J.Barthere and M.Laudet.

Phys. Radium, Vol. 20, Suppl. No. 7, 80A-90A (July, 1959). French.

Electro-optical characteristics of magnetic electron lenses can calculated if the induction B on the lens axis with its derivatives $' = dB/dz$ and $B'' = d^2B/dz^2$ are known. These three values can be tained with accuracy from a single measurement of the flux through circle of any radius, the centre of which is on the axis, by a matrix oduct using an elementary solution, calculated once and for all. e efficiency of this method is proved by the results given. These ll permit the completion of data on magnetic electron lenses cessary for apparatus building.

537.533

19746 FIFTH ORDER SPHERICAL ABERRATION OF MAGNETIC LENSES. G.D.Archard.

rit J. appl. Phys., Vol. 11, No. 11, 521-2 (1960).

Knowledge of the fifth order spherical aberration of magnetic nses is required in order to show how much error is left when ird order aberration is corrected. This is found theoretically for nses of the bell-shaped field type. It is found that, for lenses of moderate strength, third and fifth order coefficients are numerically very similar.

537.533

19747 SIMPLE METHOD OF CALCULATION FOR ELECTROSTATIC LENSES. N.J.Félici.

J. Phys. Radium, Vol. 20, Suppl. No. 12, 97A-109A (Dec., 1959). In French.

Gives a computing method which is an extension of the weak lens formulae based on the Picht equation. Even in the case of very strong electrostatic lenses, the numerical error does not exceed a few percent. The most tedious part of the computation is the graphical evaluation of an integral which requires no more than five to ten minutes. This method enables the average scientist or engineer to get a quick and precise insight into the performance of electron lenses. In the case of weak lenses, new formulae with series expansions are given, and some properties of those lenses are established.

537.533

19748 DEPTH OF FOCUS OF THE ELECTRON-OPTICAL IMAGE [FORMED] BY ELECTROSTATIC IMMERSION OBJECTIVES. G.Bartz.

Optik, Vol. 17, No. 3, 135-42 (March, 1960). In German.

The Abbe sine condition is used to derive an approximate formula for the depth of focus of electrostatic immersion objectives, on the assumption that the aperture is reduced by a diaphragm. The application of the formula to an electrostatic immersion objective used by the author in an electron microscope (secondary electrons) shows that a depth of focus may be expected about five times greater than that obtained with an optical microscope. Comparison measurements with interference, optical and electron microscopes are in good agreement with this result. The advantages for surface microscopy are illustrated.

537.533

19749 MEASUREMENT OF THE SPHERICAL ABERRATION OF ELECTROSTATIC QUADRUPOLE LENSES.

A.Septier and J. Van Acker.

C.R. Acad. Sci. (Paris), Vol. 251, No. 3, 346-8 (July 18, 1960). In French.

Describes measurements of the spherical aberration of an electrostatic quadrupole lens operating at 10 kV and traversed by 50 keV electrons. It is shown that the electrical symmetry about the optical axis of the voltage applied to the quadrupole influences the spherical aberration coefficient. A.E.I. Research Laboratory

537.533 : 537.54

DIVERGING ELECTROSTATIC LENSES IN ACCELERATORS. See Abstr. 19819

537.533 : 621.385.833

19750 A STUDY OF APERTURE-TYPE ELECTRON LENSES WITH SPACE CHARGE. L.A.Harris.

J. Electronics and Control, Vol. 8, No. 4, 241-65 (April, 1960).

The electron-optical action of round and slit apertures in the anodes of parallel-plane diodes is investigated. The influence of aperture size on the space-charge-limited current is calculated and included in the determination of paraxial electron trajectories. The results computed by machine are expressed in terms of an effective thin lens whose position and strength are modified from the usual values. The effective focal length is somewhat shorter than predicted by simple lens formulae while the position of the equivalent lens moves farther from the cathode as the aperture size increases. Experiments on devices similar to that analysed give limited confirmation of the theory. They also demonstrate several effects of practical significance which are not treated theoretically.

537.533

19751 DESIGN OF ALTERNATING GRADIENT QUADRUPOLE LENSES. J.Rosenblatt.

Nuclear Instrum. and Methods, Vol. 5, No. 3, 152-5 (Sept., 1959).

A graphical method is described by means of which it is possible to design quadrupole lenses once locations of object and image are given. It is shown that similar procedures would be valid in the para-axial (Gauss) approximation, when applied to electron optical devices of any kind.

537.533

19752 PHASE CONTRAST IN ELECTRON MICROSCOPY. J.Faget, J.Ferre and C.Fert.
C.R. Acad. Sci.(Paris), Vol. 251, No. 4, 526-8 (July 25, 1960). In French.

A slit source is placed in the condenser lens. At the image plane of this slit, between the intermediate lens and the projector, a phase plate is inserted. In this position its centration and movement are easily controlled. The phase plate is made by laying a fine thread, about 0.3μ diameter, across a collodion film mounted on a grid and coating with a layer of evaporated carbon. After evaporation, the thread is removed leaving a slightly thinner zone. With about 150 A thickness of carbon a phase retardation of $\pi/2$ is obtained. To avoid contamination of the phase plate and to allow adjustments to be made, it is maintained at 200°C by a small heating coil. Preliminary results are encouraging and as expected, striking contrast differences are observed. R.Reed

537.533

19753 THE ACCURACY OF THE DIFFRACTION PATTERNS IN THE ELMISKOP I. R.Weiner and C.Schiele.
Naturwissenschaften, Vol. 47, No. 10, 221-2 (1960). In German.

The ring diameters in diffraction patterns from small selected areas of a specimen are measured using a viewing microscope. Tests with the Elmiskop have shown that the wavelength of the electron beam is sufficiently constant over long working periods to differentiate between patterns from the various areas. By this means, at least four components in cathodic films on metals have been recognized. R.Reed

537.533

19754 EFFECT OF FLUCTUATING OBJECT ILLUMINATION ON THE ELECTRON OPTICAL IMAGE.
E.Gütter and H.Mahl.
Optik, Vol. 17, No. 5, 233-43 (May, 1960). In German.

With fluctuating illumination of the object (even 50 c/s heating of the cathode could cause such fluctuations), blurring of the final image has been observed, especially when specimen grids are used. It has been shown that thermal fluctuations in the specimen grid are responsible. Apart from specimen grids, an experimental determination of the frequency dependence of the amplitude of this thermal fluctuation has been carried out in other cases, in particular for the simple case of a wire inserted on one side. Good agreement has been obtained with values deduced theoretically. For large values of ω, the amplitude of fluctuation tends to zero according to $\omega^{-3/2}$. A peculiar effect is the appearance of resonant fluctuations for high frequencies, particularly in the case of a wire inserted on both sides, and for specimen grids. From the point of view of harmful effects on the object, an intermittent illumination of the object is not significantly less favourable for the frequencies in question than direct current illumination.

537.533 : 539.27

SELECTED-AREA DIFFRACTION IN THE ELECTRON MICROSCOPE. See Abstr. 18420

537.533

19755 A LARGE PERMANENT MAGNET BETA-RAY SPECTROGRAPH. M.S.Mladjenović.
Bull Inst. Nuçlear Sci. "Boris Kidrich", Vol. 6, 53-68 (March, 1956).

A large permanent magnet beta-ray spectrograph is described. The pole-pieces are 100 × 60 cm with the maximum path radius of 44 cm. Photographic plates or two G.M. counters can be used alternatively as detectors.

537.533

19756 STUDY OF THE CHARACTERISTICS OF A BETA SPECTROGRAPH USING A MAGNETIC FIELD WITH rH CONSTANT. C.Bastard, J.Lafoucrière and R.Margrita.
J. Phys. Radium, Vol. 20, No. 8-9, 736-41 (Aug.-Sept., 1959). In French.

A study has been made of the characteristics of a β spectrograph using an inhomogeneous magnetic field of constant rH. The twisted paths of the charged particles are computed with an I.B.M. 650 calculator for the determination of axial aberrations of sphericity.

537.5

19757 ON THE POSSIBILITY OF APPLYING TROCHOIDAL ORBITS IN BETA-SPECTROSCOPY. K.G.Malmfors.
Nuclear Instrum., Vol. 1, No. 5, 251-2 (Sept., 1957).

The trochoidal motion of beta-particles in a strong slightly inhomogeneous magnetic field was first studied by Thibeau. The following two essential properties were pointed out: (1) positive and negative particles are directly separated since the drift motic goes in opposite directions in the two cases; (2) the transmission can be made very high because a large fraction of all particles emitted from a point source take part in the trochoidal beam. An instrument has been constructed with the purpose of separating positive and negative electrons. The possibility is discussed of constructing a beta-spectrometer according to this principle, whe the high transmission can be combined with a fairly good resolutic by measuring the β-energies by the time-of-flight technique. It seems likely that the direct separation of positive and negative electrons may be of special importance for the construction of a pair-spectrometer.

537.53

19758 A LONGITUDINAL β-SPECTROMETER WITH COMPENSATED SPHERICAL ABERRATION.
K.A.Dolmatova and V.M.Kelman.
Nuclear. Instrum. and Methods, Vol. 5, No. 5, 269-79 (Nov., 1959).

For brief report see Abstr. 8657 of 1957. A new method for the compensation is described. On the homogeneous magnetic fiel is superimposed a correcting field generated by means of an special coil system placed inside the spectrometer. Theoretical and experimental investigations of the focussing properties are given and it is shown that the compensation coils gives a considerable reduction of the spherical aberration. With a 1×1 mm^2 source a relative halfwidth of 1.4% and an effective transmission of 5.2% was obtained. At a resolution of 1.9% the effective transmission was found to be 6.5%. A Ø 5 mm source gave a resolution of 3%.

537.53

19759 THEORY OF A HIGH DISPERSION DOUBLE FOCUSING BETA-RAY SPECTROMETER. H.Daniel and L.J.Lasle
Rev. sci. Instrum., Vol. 31, No. 11, 1225-8 (Nov., 1960).

A "flat" high dispersion double focusing beta-ray spectrometer is proposed and results of computations are presented. The high dispersion is achieved by making the electrons orbit around the field axis more than once. The source and detector are displaced radially, in opposite directions, from the stationary circular orbit. A suitable baffle is mounted between the source and detector to shield the detector against unwanted electrons. The electron-optica properties are almost the same as for the $\pi\sqrt{2}$ spectrometer excep that the dispersion is increased. Numerical results are presented for two instruments with focusing angles of 565.88° and 909.02°, with respective dispersions of 21.5 and 50.6, to be compared with a dispersion of 4 for the $\pi\sqrt{2}$ spectrometer.

537.53

19760 SHIFT OF AN ELECTRON INTERFERENCE PATTERN BY ENCLOSED MAGNETIC FLUX. R.G.Chambers.
Phys. Rev. Letters, Vol. 5, No. 1, 3-5 (July 1, 1960).

The fringes produced by a "Fresnel biprism" are found to become tilted when a tapering iron whisker is placed between the two beams, indicating a phase shift due to the enclosed flux, as predicted by Aharonov and Bohm (Abstr. 12997 of 1959). R.G.Chamber

537.533 : 539.2 : 548.

INTERNATIONAL SYMPOSIUM ON ELECTRON DIFFRACTION See Abstr. 18334

537.53

19761 DYNAMICAL THEORY OF ELECTRON DIFFRACTION IN LAUE-CASE, I. GENERAL THEORY. F.Fujimoto.
J. Phys. Soc. Japan, Vol. 14, No. 11, 1558-68 (Nov., 1959).

A new formulation of the theory of electron diffraction for the Laue-case, based upon the matrix representation of Niehrs and Wagner, is presented by introducing the scattering matrix for an electron elastically scattered by a plate-like crystal. The intensity and also the integrated intensity of reflections for thin crystals are ited. The results obtained here indicate that the intensity does proach to that of the pseudo-kinematical theory, but to that of nematical theory. The theory predicts also the failure of el's law in the case of non-centro-symmetric crystals. The la for the scattered amplitude can be transformed into the which coincides with the result given by Cowley and Moodie ed on the basis of the Huygens' principle.

537.533

762 IMPROVED LOW ENERGY ELECTRON DIFFRACTION APPARATUS. L.H.Germer and C.D.Hartman.

sci. Instrum., Vol. 31, No. 7, 784 (July, 1960).

more compact design of electron gun, 46 mm long, with a ated tantalum cathode and molybdenum grids, which produces beams down to 15 eV, is shown. The entire diffraction rn is observed directly and not via a mirror as previously.

R.Reed

537.533

763 THE CHARACTERISTIC ELECTRON ENERGY LOSS SPECTRA OF ALUMINIUM—MAGNESIUM AND MINIUM—COPPER ALLOYS. C.J.Powell.

ral. J. Phys., Vol. 13, No. 2, 145-52 (June, 1960).

The characteristic electron energy loss spectra of 1500 eV trons scattered by aluminium—magnesium and aluminium— er alloys were measured. A plasma and a lowered plasma gy loss were observed in the alloys, and it was found that ace oxidation caused the disappearance of the lowered plasma and the appearance of a new modified lowered plasma loss. gh the compositions of the evaporated alloy specimens were own, the three energy losses were observed to vary continuou- etween the values observed for the three elements. This con- us change can be interpreted in terms of the changing free tron density in alloys of varying composition. It is concluded measurements of the characteristic loss spectra of alloys differentiate between losses due to individual and collective tron excitation.

537.533 : 539.19

9764 ENERGY LOSSES OF ELECTRONS PASSING THROUGH GASES HYDROGEN, OXYGEN, NITROGEN, AIR, BON DIOXIDE, METHANE AND ACETYLENE. S.Arai.

Rep. Tohoku Univ. First Ser., Vol. 43, No. 1, 6-12 (June, 1959).

Energy losses of 20 keV electrons passing through the gases ogen, oxygen, nitrogen, air, carbon dioxide, methane and ylene were measured by the method described in a previous er (Abstr. 10969-70 of 1960). Energy losses for oxygen, ogen and air are compared with the data given by Dietrich str. 8813 of 1958). Only a discrete energy loss found for hydro- numerically corresponds to an optical term of an excited tronic state of the hydrogen molecule. However, the number of rete energy losses measured for all the gases is much less the number of excited electronic states of gas molecules to be ected from optical terms, while energy loss spectra correspon- to the ionization of molecules exist for all the gases studied.

537.533

19765 PENETRATION OF ELECTRONS INTO SOLIDS. I. INTENSITY OF THE ELECTRON BEAM. ANSVERSE PATHS OF ELECTRONS. A.F.Makhov.

. tverdogo Tela, Vol. 2, No. 9, 2161-71 (Sept., 1960). In Russian.

A method is described for obtaining curves which describe intensity of the electron beam and are universal either with spect to the initial electron energy or with respect to the thick- s of layers. Experimental formulae were obtained for the in- sity curves for Al, Si, Cu, Ge, Bi and Al_2O_3. The transverse ctron paths which form the path spectrum are related to initial rgy by functional relationship of the same form, while the ratio any path to the mean-square or mean path does not depend on initial electron energy. A method of extrapolation used for termining the path/energy relationship is discussed.

F.Lachman

537.533

19766 PENETRATION OF ELECTRONS INTO SOLIDS. II. DEPTH DISTRIBUTION OF ELECTRONS.

.F.Makhov.

iz. tverdogo Tela, Vol. 2, No. 9, 2172-5 (Sept., 1960). In Russian

The distribution was calculated for Al, Si, Cu, Ge, Bi and Al_2O_3. It was demonstrated that the distribution can be presented in a form which is universal with respect to the initial electron energy. It was deduced that, within the depths of distribution, no narrow layer could be isolated, in which the absorption of the beam electrons could be said to be localized.

F.Lachman

537.533

19767 PENETRATION OF ELECTRONS INTO SOLIDS. III. ABSORPTION OF THE ENERGY OF THE ELECTRON BEAM. A.F.Makhov.

Fiz. tverdogo Tela, Vol. 2, No. 9, 2176-84 (Sept., 1960). In Russian

The distribution of electrons by their energies at any depth of a solid was calculated. The beam electrons were shown to penetrate into the solid, while possessing a considerable scatter of energy, whose magnitude can be determined from the scatter formula. The mean electron energy and its dependence on depth were calculated. Curves were obtained for the energy absorption of an electron beam in Al, Si, Cu, Ge, Bi and Al_2O_3.

F.Lachman

537.533

19768 ANOMALOUS ELECTRON ABSORPTION EFFECTS IN METAL FOILS.

H.Hashimoto, A.Howie and M.J.Whelan.

Phil.Mag. (Eighth Ser.), Vol. 5, 967-74 (Sept., 1960).

The dynamical theory of electron diffraction, including a term to take account of absorption, was applied to explain some contrast anomalies observed at extinction contours and stacking faults on transmission electron micrographs of metal foils. The theory is at present phenomenological because the detailed mechanism of the absorption process is not understood. This paper reports some preliminary results of the theory and compares them with observations.

ION EMISSION . ION BEAMS

537.534 : 537.56

19769 ION AND PLASMA SOURCES.

T.Consoli, P.Hubert, R.Le Quinio and D.Véron.

Nuclear Instrum. and Methods, Vol. 4, No. 5, 376-81. In French.

A short survey is given of existing ion and plasma sources with special reference to their application in thermonuclear work.

537.534

19770 CHARACTERISTICS OF A HIGH FREQUENCY ION SOURCE. M.Seki, A.Katase, Y.Wakuta and M.Sonoda.

Mem. Fac. Sci. Kyusyu Univ. B, Vol. 3, No. 1, 9-14 (March, 1960).

The characteristics of a high frequency ion source have been investigated theoretically and compared with the results so far obtained, especially for the canal geometry. The optimum is obtained when the depth of the canal tip from the upper end of the sheath is nearly equal to the inner diameter of the sheath. The relation between the ion beam and the high frequency power was also investigated and it was found that more than 300 watts was necessary to obtain an intense ion beam of a few milliamperes.

537.534

19771 FUNCTIONAL CHARACTERISTICS OF H.F. ION SOURCES WITH DIAPHRAGMS INSIDE THEIR EXTRACTING CHANNELS. D.Blanc and A.Degeilh.

J. Phys. Radium, Vol. 20, Suppl. No. 7, 55A-58A (July, 1959). In French.

An h.f. source, producing a positive argon ion beam is described, and its operational features given, with and without a diaphragm inside its extracting channel. If a diaphragm of one mm diameter is introduced when the argon pressure is 15 μ of Hg in the ionization chamber, gas consumption will be reduced in a proportion of 4.24; however, the source will produce an ion beam 60% of that obtained without a diaphragm. Optimum operating conditions are established for the same pressure; they correspond to an extracting voltage of about 5000V. The value of the current obtained is a function of gas pressure in the source; the current has a maximum pressure of 6 μ of Hg without a diaphragm, and 8 μ of Hg with a diaphragm.

537.534

19772 ON SOME PROPERTIES OF THE RADIO FREQUENCY ION SOURCE WITH LONGITUDINAL MAGNETIC FIELD. V.J.Kowalewski, C.A.Mayans and M.Hammerschlag.
Nuclear Instrum. and Methods, Vol. 5, No. 2, 90-4 (Aug., 1959).

A description is given of a radio frequency ion source of the Thoneman type, but with a coaxial magnetic field. It is shown that with proper choice of the measured variables simple straight line plots are obtained which can be given easy interpretation and be useful in further developments. Some limitations of this type of source are also shown.

537.534

19773 NATURAL MODULATION OF HIGH FREQUENCY ION SOURCE BEAMS. G.C.Phillips, E.B.Paul, A.T.G.Ferguson, A.B.Whitehead, T.Grjebine, R.Moreau and B.Olkowsky.
Nuclear Instrum., Vol. 3, No. 1, 43-4 (July, 1958).

In the course of developing techniques to allow time-of-flight measurements using the Harwell 5 MeV Van de Graaff accelerator, it was discovered that the beam is naturally strongly modulated in time with the frequency of the r.f. ion source. Similar experiments on the two Van de Graaff accelerators at Saclay have indicated similar modulation. At Harwell, the beam from the accelerator, after 90° magnetic deflection, was allowed to strike a fine lead glass fibre whose scintillations were observed with a photomultiplier and fast oscilloscope. A saw-tooth wave, with each alternate peak more intense, was observed; the two principal frequencies in these pulses were about 15 and 30 Mc/s. By interposing parallel plates excited by a radio frequency oscillator between the magnetic analyser and the glass fibre (a device designed to pulse the beam) it was possible to allow only short bursts of the natural beam to strike the glass fibre. The variation of signal with deflector oscillator frequency demonstrated that the natural modulation was near 100% and that the beam naturally consists of short pulses of a repetition period of 33 msec. The oscillator driving the ion source discharge has two strong frequencies present: 15 and 30 Mc/s. The beam modulation is also detectable with an ordinary communications radio receiver by plasing a short antenna near the brass vacuum tube transmitting the proton beam.

537.534

19774 RADIOFREQUENCY MODULATION IN THE THONEMAN ION SOURCE. J.Erő.
Nuclear Instrum., Vol. 3, No. 5, 303-6 (Nov., 1958).

A fast energy analyser using a scintillation detector has been made which is able to trace the spectrum in 20 μs. It is shown that the ion beam has r.f. modulation of about 50 eV. A demodulating r.f. field after the exit channel eliminates this modulation if the ions pass through it at right phase, and thus the energy spread of the beam is diminished below 10 eV. By determining the time of flight of ions from the r.f. modulation to the demodulating field the conclusion was drawn that the r.f. modulation occurs immediately near the cathode.

537.534

19775 PULSED HIGH-INTENSITY ION SOURCE. I. J.Flinta.
Nuclear Instrum., Vol. 2, No. 3, 219-26 (April, 1958).

Deals with the limitations of the discharge current extraction of ions and focusing of large ion current beams. Three types of ion sources are described and their data are given.

537.534

19776 PULSED HIGH-INTENSITY ION SOURCE. II. R.Pauli and J.Flinta.
Nuclear Instrum., Vol. 2, No. 3, 227-36 (April, 1958).

Deals with detailed investigation of the characteristics of the discharge of the Penning type. For this purpose a special ion source was built which allowed for the exchange of all inner parts.

537.534

19777 THE DEVELOPMENT OF MAGNETIC ION SOURCES FOR AN ELECTROMAGNETIC ISOTOPE SEPARATOR. K.O.Nielsen.
Nuclear Instrum., Vol. 1, No. 6, 289-301 (Dec., 1957).

A survey is given of several ion sources of the magnetic type, which have been used in connection with the electromagnetic isotope
separator in Copenhagen. The first types constructed for handlin
are described briefly, while ion sources for solids are discusse
greater detail. The temperature of the discharge chamber can
raised to about 1100°C. The evaporation rate is controlled by t
temperature of the sublimation furnace. Problems in connectio
with the maintenance of optimal pressure in the discharge cham
by adjusting the furnace temperature are discussed.

53

19778 SYSTEMATIC INVESTIGATION OF A MAGNETIC I
SOURCE FOR AN ELECTROMAGNETIC ISOTOPE
SEPARATOR. O.Almén and K.O.Nielsen.
Nuclear Instrum., Vol. 1, No. 6, 302-22 (Dec., 1957).

The properties of a magnetic ion source with oscillating el
trons are studied. The ion source is operated in connection wit
electromagnetic isotope separator. Special interest is devoted
the obtainable ion currents, the resolving power of the instrume
and the efficiency of the ion source. The ion current and the re
ing power can be varied within wide limits. However, if the ion
source is operated at conditions corresponding to maximum res
ing power, it is found that the ion current is limited by space ch
in the ion extracting device. By measurements of the paramete
the ion source, performed at maximum resolving power, an inve
gation of the plasma discharge was possible. It was found that,
maximum resolving power, a constant ion production rate was
required, determined only by the extracted ion current. Applyin
this result the influence of different factors on the efficiency of t
ion source was calculated. The efficiency appeared to be propor
to the length of the discharge chamber and to the ionization cros
section. This was also verified experimentally.

537.

19779 TWO LITHIUM ION SOURCES FOR ACCELERATORS
I.Cornides, J.Roósz and A.Siegler.
Nuclear Instrum., Vol. 1, No. 2, 94 (March, 1957).

Two types of Li ion sources developed for the investigation
charge-exchange and nuclear reactions by accelerated Li ions, a
described and preliminary results concerning their performance
given.

537

19780 ION SOURCE FOR RADIOISOTOPE SEPARATION.
J.O.Burgman and G.Andersson.
Nuclear Instrum., Vol. 3, No. 1, 33-42 (July, 1958).

An ion source of the oscillating electron type with axial mag
netic field and end extraction has been constructed for electromagnetic separation of synchrocyclotron-produced radioactive
isotopes. A description of the ion source and the results of some
systematic investigations of its properties are given. The perfo
ance of the ion source is illustrated by some recent applications
prepare sources for spallation studies and nuclear spectroscopy

537.534 : 621.3

19781 GROWTH OF ELECTRON SPACE-CHARGE AND RA
WAVES IN MOVING ION STREAMS. R.Q.Twiss.
Phil. Mag (Eighth Ser.), Vol. 4, 868-75 (July, 1959).

A criticism is given of a paper by Piddington with the same
title (Abstr. 7111 of 1959). It is shown that his belief that the
growing waves in a two-stream electron wave tube are really ev
escent is untenable and that his own theory is effectively equivalent to the conventional one in which these growing waves are
identified as being true amplified waves. Piddington's conclusio
that an initial disturbance in a two-stream medium will grow ex
nentially with time without oscillation is shown to be a conseque
of highly idealized assumptions as to the nature of the medium a
as to the initial and boundary conditions. In any practical case i
argued that double stream flow will build up oscillations at frequencies, in general around the plasma frequency, rather than
produce charge separated blobs as in Piddington's theory. If te
perature effects are allowed for it is shown that double stream f
does not occur in the corona in the case discussed by Piddington
and reasons are also given for rejecting a theory of growing wa
in shock fronts advanced by Sen. Piddington's reasons for rejec
the existence at transverse space charge waves in a drifting ion
medium and for denying that growing evanescent waves can be
excited by reflection are shown to be invalid. This removes Pid
ton's objection to an earlier theory of excess solar radio wave p
forward by the writer, but it is agreed that this theory must now
be rejected on other grounds. In an editorial note (ibid, p.876),

ated that this paper by Twiss was submitted to Piddington in ope of securing some agreement between them, but that the ors have not found it possible to accept each other's views.

537.534 : 539.18

9782 THE STABILITY OF ION BEAMS IN ELECTRO-MAGNETIC ISOTOPE SEPARATORS.
assignol, P.Lazeyras and G.Ranc.
hys. Radium, Vol. 19, Suppl. No. 12, 147A-149A (Dec., 1958).
rench.

Intensity and resolution losses in the operation of the isotope arators when the pressure is very low are explained by the sence of a random residue of space charge due to the fluctuations ntensity of the ion beams. Consequently, a doubt arises about the ease of the energy spread when the ion source works in an eady state.

537.534

19783 AN A.G. CHANNEL WITH FOUR QUADRUPOLE MAGNETS. H.Schneider.
lear Instrum., Vol. 1, No. 5, 268-73 (Sept., 1957).

The known formalism of transformation matrices for the path a charged particle in a magnetic quadrupole field is used to luce the formulae for focus, image and object distances for a gle magnet and solid angles for a system. The magnets are ated as lenses and a focussing system is constructed. From the hs in this system, conditions for the magnetic fields are found, l these conditions are shown to correspond to a simple set of ations, which are solved graphically. The usefulness of this thod was checked in an experimental set-up with monochromatic ectrons from an electron-gun. The caustic was measured and working conditions were found to be in agreement with the lculations. The approximations made in calculation and experi- ent are discussed.

537.534 : 518.5 : 681.142

19784 ANALOG COMPUTER FOR CHARGED PARTICLE TRAJECTORIES. R.H.Good and O.Piccioni.
v. sci. Instrum., Vol. 31, No. 10, 1035-9 (Oct., 1960).

An analogue computer has been applied to the problem of tracing e trajectories of a beam of charged particles such as is produced high energy accelerators. The electrical circuit involved em- loys analogues for both quadrupole magnets and bending magnets, d thus it facilitates the determination of both the focal properties d the dispersion characteristics of the magnets; an accuracy as od as 2% has been attained for some of the calculations made with e present instrument.

537.534

19785 TRANSFORMATION OF A FIRST ORDER FOCUS INTO A SECOND ORDER FOCUS IN A HOMOGENEOUS FIELD AGNETIC SPECTROGRAPH. R.J.Walen.
uclear Instrum., Vol. 1, No. 5, 242-50 (Sept., 1957). In French.

A magnetic lens is described which corrects for the aberrations a homogeneous magnetic field spectrograph, when inserted gether with the defining slit of the beam of charged particles. The ns is essentially correct for the narrow slit such as used in cusing heavy particles, when axial aberration remains unimportant.

537.534

19786 MASS SPECTROGRAPHS WITH FIRST ORDER DOUBLE FOCUSING FOR ALL MASSES, EXHIBITING MALL ABERRATIONS IN A LARGE MASS RANGE OVER THE HOTOGRAPHIC PLATE. H.Hintenberger and L.A.König.
uclear Instrum., Vol. 3, No. 5, 250-9 (Nov., 1958). In German.

The properties of the abberation coefficients of mass spectro- raphs with first order double focusing along a straight image ne are examined. In a previous paper (see Abstr. 11136 of 1960), was shown that at one point of the image line two or three of the berration coefficients are zero. It results that for some of these struments, besides the mentioned advantages, further improve- ents are possible. There exist not only instruments in which ome aberration coefficients vanish in additional points at the hotographic plate, but also instruments with small aberration oefficients in a wide range of the plate. The dimensions of espe- ially favourable mass spectrographs are given in a table, the rogress of the aberration coefficients belonging to them is shown diagrams and the positions of the zero points of the coefficients re indicated in a table.

537.534

19787 ELIMINATION OF THE RADIAL SECOND ORDER ANGULAR ABERRATIONS IN INHOMOGENEOUS FIELD MASS SPECTROMETERS BY INCLINED PLANE BOUNDARIES. H.A.Tasman and A.J.H.Boerboom.
Z. Naturforsch, Vol. 15a, No. 8, 736-8 (Aug., 1960).

Extension of previous work. See Abstr. 7096 of 1959 and 281-2, 5360 of 1960. J.W.Sturgess

537.534

19788 ABERRATIONS AND FRINGING EFFECTS IN A 180° DOUBLE FOCUSSING MAGNETIC SPECTROMETER.
D.L.Judd and S.A.Bludman.
Nuclear Instrum., Vol. 1, No. 1, 46-52 (Jan., 1957).

Second and third order effects, including fringing, are considered for a 180° symmetrical double focusing spectrometer. The optic axis and focal points for particles of a definite momentum are found. Values are calculated for β and γ, the coefficients of the quadratic and cubic terms in the expansion of the magnetic field, which eliminate second and third order aberrations due to radial motion. The linear dispersion and the orientation of the focal plane for paraxial trajectories of slightly different momenta are determined. Numerical values are presented for a high transmission alpha-particle spectrometer.

537.534

19789 MASS SPECTROMETRIC ION-DETECTION WITH AN ION CONVERTER DETECTOR. E.Schönheit.
Z. Naturforsch., Vol. 15a, No. 9, 839-41 (Sept., 1960). In German.

Describes an arrangement for measuring ion currents down to about 10^{-18} amp. The ions strike a beryllium-copper target and the resulting secondary electrons are accelerated onto the fluorescent screen of a suitable scintillation counter. A range of spectral intensities of a million to one can be handled.
A.E.I. Research Laboratory

537.534

19790 THEORY OF THE 90° DEFLECTRON MASS SPECTROMETER. III. IDEAL MAGNETIC FIELD AND TRAJECTORIES OUTSIDE THE PLANE OF SYMMETRY. PEAK FORM AND RESOLVING POWER. D Charles.
Ann. Radioelect., Vol. 15, 253-75 (July, 1960). In French.

For Pt II, see Abstr. 7968 of 1957. It is first shown that the collector diaphragm limits the importance of the image curvature due to trajectories outside the plane of symmetry, so that in practice this curvature can be neglected. Next the problem of faults in parallelism of the object slit and collector slit is examined. It can be concluded that if the lack of parallelism is slight it is always possible to align the image of the object slit on the collector slit by means of the analyser electromagnet, but that it is better to provide for separate motions respectively parallel to the entry and exist sides of the 90° magnetic sector. It is shown in practice that it is always preferable to retain adjustment for the orientation of the collector slit if a high resolution is required. The shape of the peaks, which is the main guide for adjusting the mass spectrometer, is examined, taking into consideration the lack of parallelism of the image of the object slit and of the collector slit, and then taking into consideration the initial ion velocity distribution. The various definitions for the resolving power are reconsidered in relation to the results concerning the shape of the peaks. The theoretical results are compared with the experimental results.

537.534

19791 THE PALLETRON AS A HIGH-FREQUENCY MASS SPECTROMETER. H.B.Valentini.
Exper. Tech. der Phys., Vol. 8, No. 2, 65-81 (1960). In German.

Describes the Palletron, which originally was an electron beam tube in which electrons were accelerated by an r.f. field in an electrostatic parabolic field. Resonance occurred at a critical radiofrequency. The paper considers the use of the Palletron as a mass spectrometer since the critical frequency varies with e/m. The theory of the device is investigated and some experimental results are given. A.E.I. Research Laboratory

537.534

19792 SMALL GENERAL PURPOSE DOUBLE FOCUSING MASS SPECTROMETER. A.O.Nier.
Rev. sci. Instrum., Vol. 31, No. 10, 1127-32 (Oct., 1960).

A small performance double focusing mass spectrometer employing a 90° electrostatic analyser and a 60° magnetic analyser is described. The radius of curvature of ion paths in the magnetic analyser is 2 in. As a laboratory instrument for making gas or isotope analyses, its sensitivity and resolution make it competitive with instruments several times as large employing only a magnetic analyser. With a permanent magnet the weight and power consumption are both low, making it attractive for applications where these factors may be of importance.

537.534

19793 EMISSION REGULATOR DESIGNED FOR MASS SPECTROMETER USING A CHOPPER AMPLIFIER.

W.Corfield, H.McCullough and J.Lipson.
Rev. sci. Instrum., Vol. 31, No. 10, 1153-5 (Oct., 1960).

537.534

19794 TRANSMISSION OPTICS OF FOCUSED ION BEAMS USED IN MASS SPECTROMETRY.

L.A.Dietz.
Rev. sci. Instrum., Vol. 31, No. 11, 1229-33 (Nov., 1960).

Current density profiles and angular spreading of low intensity positive ion beams are measured with scanning slits in an evacuated beam analyser. Experimental measurements are made of spherical aberration and transverse thermal velocity at a crossover focused by an ion gun. Spherical aberration is determined by an extrapolation technique which apparently has not been used before. Beam constants were evaluated for an ion gun used with V-type, flat ribbon, and multiple filaments. Each type of surface ionization filament produces a beam of elliptical cross section. Expressions are given for the variations of current density in a plane normal to and moved along the beam axis in field-free image space, and for the beam fraction transmitted through a rectangular aperture. Application of the results to estimate the degree of voltage and mass discriminations is briefly discussed.

537.534 : 533.5

LENS MASS-SPECTROMETER LEAK DETECTOR.

See Abstr. 19237

537.534

19795 ELECTROMAGNETIC ISOTOPE SEPARATOR IN GOTHENBURG.

O.Almén, G.Bruce and A.Lundén.
Nuclear Instrum., Vol. 2, No. 3, 249-60 (April, 1958).

A 90° electromagnetic isotope separator with a beam radius of 100 cm is described. Using an acceleration voltage of 50 kV, ion current of up to a few hundred µA can be handles. The ion current and resolving power can be varied within wide limits by adjusting the position of the lens system during operation. Two types of magnetic ion sources have been used to prepare targets for nuclear reaction studies and samples for beta- and gamma-ray spectroscopy.

537.534

19796 CONTINUOUS SCANNING IN TWO DIRECTIONS OF THE ION BEAM IN AN ELECTROMAGNETIC ISOTOPE SEPARATOR.

K.O.Nielsen and O.Skilbreid.
Nuclear Instrum., Vol. 1, No. 3, 159-65 (May, 1957).

A system is described for continuous supervision of the shape and position of the image in the focussing plane of an electromagnetic isotope separator. Two thin needles one horizontal and one vertical are moved through the fixed beam. In this way a picture of the extension of the beam in both directions is obtained on an oscilloscope screen. Since even small changes in the shape of the beam can be observed, it is possible to maintain the focussing condition at maximum resolving power, and thereby to increase the effective separation power. The amplitude of the needle oscillation can be adjusted so that the whole mass spectrum of any element, except hydrogen, is covered.

537.534

19797 60° SECTOR TYPE ELECTROMAGNETIC ISOTOPE SEPARATOR IN THE INSTITUTE OF NUCLEAR SCIENCES — BELGRADE.

I.F.Ševarac, B.D. Perović, B.V.Dunjić and R.M.Protić.
Nuclear Instrum., Vol. 3, No. 5, 245-9 (Nov., 1958).

A 60° sector type electromagnetic isotope separator with homogeneous magnetic field is described. The radius of the ion path is 75 cm. The ion source of magnetic type with oscillating electrons is used. Characteristics of the separator and results of measurements are given.

537

19798 CROSSED ELECTRIC AND MAGNETIC FIELD MUL CHANNEL ION ANALYZER.

L.E.Bailey.
Rev. sci. Instrum., Vol. 31, No. 10, 1147-52 (Oct., 1960).

A multichannel mass and energy analyser using crossed ele tric and magnetic fields for ion separation has been constructed analyse plasmas produced in conjunction with a magnetic mirro machine. Ions are piped between the strong magnetic field of th mirror machine and the weaker magnetic field of the analyser b auxiliary magnetic coils, and they enter the analyser travelling a direction nearly parallel to the magnetic field. There, the ions are accelerated by the electric field and assume cycloid-like trajectories in the plane perpendicular to the magnetic field. The ions are collected by detectors located at the top of the cycloid. The amplitude of the cycloid is determined by the e/m of the ion the distance traversed parallel to the magnetic field before colle tion is proportional to the velocity of the ion.

537.

19799 EFFECT OF MAGNETIC STRAY FIELD ON THE LOCATION OF IMAGE IN NUCLEAR SPECTROMETE

I.Berkes.
Acta phys. Hungar., Vol. 9, No. 1-2, 13-21 (1958).

The effect on particle trajectory of fringing fields at the edge of sectorial magnetic fields in nuclear spectrometers can be partially allowed for by assuming a uniform field B_0 to act over a well-defined region larger than the actual magnet sector with zer field outside this region. However, in this case, the image is, in practice, shifted laterally from its calculated position, and the sh usually compensated for by altering the field intensity. Under the conditions the quantity $(B_0 \cdot r_0)$ representing the particle momentu deviates from the product $(B_0)\cdot(r_0)$ of the two quantities measured independently, where r_0 is the geometrically defined deflection radius. Calculations are made of the lateral image displacement and the field change required to compensate for it, and the result were checked experimentally. R.E.Mea

537.5

19800 USE OF AN IMAGE CONVERTER IN EMISSION MICRO SCOPY WITH NEGATIVE IONS.

R.Bernard, R.Goutte and C.Guillaud.
J. Phys. Radium, Vol. 20, No. 12, 981-2 (Dec., 1959). In French.

The authors point out that although useful images of metallic surfaces can be obtained with negative ions knocked out by positiv ion bombardment, it is not easy to record such images without the use of an image converter. Such a device is now decribed. It converts a negative ion image into an electron image with a magnification of ten. The converter is an electrostatic immersio lens with a polished metal cathode working as an emitter of seco dary electrons under negative ion bombardment.

A.E.I. Research Laborato

537.5

19801 THE THEORY OF SCATTERING OF IONS AT METAL SURFACES.

V.H.Vapnik, L.G.Gurvich and N.V.Zinov'ev.
Izv. Akad. Nauk. SSSR, Ser. fiz., Vol. 24, No. 6, 685-8 (1960). In Russian.

"Cathode electronics Conference" Moscow, 1959 (see Abstr. 17022 of 1960). Discusses previous theories of ion emission in gases and extends the theory to ion scattering by solids. An expression is developed for the reflection coefficient for single-collision conditions and the results are compared with published experimental figures. The main discrepancy is that the experime ally determined coefficients show an energy dependence whereas t theoretical coefficients do not. Possible explanations of this discrepancy are put forward. A.E.I. Research Laborato

537.5

19802 ON THE QUESTION OF THE SCATTERING OF SLOW ALKALI IONS FROM THE SURFACE OF METALS.

U.A.Arifov, A.Kh.Ayukhanov and D.D.Gruich.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 6, 710-14 (1960). In Russian.

"Cathode electronics Conference,Moscow, 1959 (see Abstr. 17022 of 1960). Sodium and potassium ions were used to bombard targets of tungsten and nickel and their scattering coefficients we measured. Cleanliness of the surface bombarded made an apprec able difference to the output. The contributions of scattered ions, red atoms, and thermoelectric emission to the output are red. The results partly support theoretical expectations.

A.E.I. Research Laboratory

537.534 : 539.211

303 BOMBARDMENT OF METALS BY INERT-GAS IONS.

G.J.Ogilvie.

al. J. Phys., Vol. 13, No. 2a, 402-7 (July, 1960).

olid State Physics Conference (see Abstr. 17864 of 1960). the surface of a metal crystal is bombarded by inert-gas ions, atoms are knocked off the surface in certain preferred ions. Evidence is presented to show that some atoms are also ed into the crystal. A thin disoriented surface layer appears , if the crystal is an alloy, is of uniform but different composi- rom that of the original crystal. The importance of these gs to some current ideas about damage due to bombardment efly discussed and it is shown that present theories do not nt satisfactorily for the observations.

537.534

804 THE RANGE OF ALKALI METAL IONS OF KILO-ELECTRON VOLT ENERGIES IN ALUMINUM.

Davies, J.D.McIntyre, R.L.Cushing and M.Lounsbury.

d.J. Chem., Vol. 48, No. 9, 1535-47 (Sept., 1960).

A simple electrostatic accelerator capable of producing a energetic beam of alkali metal ions at energies up to 100 keV used to study the range of Cs^{137} ions in aluminium as a function ergy. The median range (R_M) increases linearly with energy edicted from the Bohr—Nielsen equation, but has a value about that predicted by this equation. Furthermore, the observed gling about the mean value is not Gaussian in shape, but con- of an asymmetric peak with a pronounced exponential "tail". possible significance of these results is discussed. Prelimin- results are given for the range of 30 keV Rb^{86} and Na^{24} ions in inium.

537.534

9805 INVESTIGATION OF THE DEPENDENCE OF ION—ELECTRON EMISSION ON CERTAIN PARAMETERS OF TARGET AND THE BOMBARDING IONS.

.Arifov and R.R.Rakhimov.

Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 6, 657-63 (1960). ussian.

"Cathode electronics Conference" Moscow, 1959 (see Abstr. 22 of 1960). Bombardment of metal surfaces by positive ions ults in the removal of electrons, partly by kinetic impingment, partly by electrostatic (potential) interaction with the ions. empts by earlier authors to separate these components have en conflicting results. In the present work special precautions void earlier errors are described, and the dependence of the etic and potential coefficients on the temperature and work ction of the targets as well as on the energy and nature of the nbarding particles is given.

A.E.I. Research Laboratory

537.534

19806 INVESTIGATION OF COLLISION OF IONS WITH METAL SURFACES.

N.N.Petrov.

. Akad. Nauk SSSR, Ser.fiz., Vol. 24, No. 6, 673-8 (1960). In ssian.

"Cathode electronics Conference",Moscow, 1959 (see Abstr. 022 of 1960). Ejection of electrons from clean W and Ta surfaces nbarded with K, H, He, and Ar ions was studied. It was inferred m the results obtained that no ejection of electrons due to the etic energy, E, of ions, striking a metal surface, can take place ess a certain threshold energy, E_t, is reached. For ions with $> E_t$, the relationship $\gamma = f(E)$, where γ is the kinetic electron ission coefficient, is linear within an energy range which in- eases with increasing mass of the bombarding particles. At mewhat higher E, the relationship $\gamma = f(v)$, where v is the ion locity, also becomes linear, and at $E \gg E_t$ the rate, at which γ reases with increasing v, decelerates. In spite of the different ucture of the electron shells of K and Ar atoms, the results (in ms of the kinetic electron emission) produced by K$^+$ and Ar$^+$ s are identical and, in the 0.5-6.0 eV range, independent of the ure of the target.

M.H.Sloboda

537.534

19807 INVESTIGATION OF INTERACTION BETWEEN FAST DEUTERIUM IONS AND METALS.

M.Gusev, M.I.Guseva, V.P.Vlasenko and N.P.Elistratov.

Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 6, 689-93 (1960). In Russian.

"Cathode electronics Conference" Moscow, 1959 (see Abstr. 17022 of 1960). The coefficient of atomization of Cu by D ions with energies of 10-30 keV, and amounts of D incorporated into Cu, stainless steel and some other metals when bombarded with 25 keV deuterons were measured, and the desorption of D adsorbed by metals was investigated when the specimen was subjected to heating.

F. Lachman

537.534

19808 ON THE QUESTION OF THE NEUTRALIZATION OF FAST POSITIVE IONS ON THE SURFACE OF A METAL.

U.A.Arifov and Kh.Kh.Khadzhimykhamedov.

Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 6, 705-9 (1960). In Russian.

"Cathode electronics Conference" Moscow, 1959 (see Abstr. 17022 of 1960). So many phenomena occur when positive ions strike a metal surface that it has hitherto been impossible to extract quantitatively the proportion of ions neutralized on contact. By an oscillographic method this has now been achieved. In effect the various kinds of secondary emission are sifted out one by one and the amount attributable to neutralization is deduced. Values are given for the impingement of Na$^+$, K$^+$, Rb$^+$ and Cs$^+$ on targets of W, Mo and Ta. The dependence of the neutralization coefficient on initial energy is also discussed.

A.E.I. Research Laboratory

537.534

19809 USE OF A MASS-SPECTROMETER OF THE DYNAMIC TYPE FOR INVESTIGATING SECONDARY PROCESSES.

A.Kh.Ayukhanov and G.I.Iskhakov.

Izv. Akad. Nauk. SSSR, Ser. fiz., Vol. 24, No. 6, 715-22 (1960). In Russian.

"Cathode electronics Conferences" Moscow, 1959 (see Abstr. 17022 of 1960). Bombardment of solid bodies by positive ions produces many simultaneous phenomena. In general attempts are made to separate these quantitatively by measuring the integrated positive and negative particle output in various directions. This proves insufficient in the case of compound or unclean target surfaces and recourse must be had to exact mass-spectrometric analysis. An application of this is described and the significance of the resulting measurements is discussed.

A.E.I. Research Laboratory

537.534

19810 SPUTTERING OF COPPER SINGLE CRYSTALS BOMBARDED WITH MONOENERGETIC IONS OF LOW ENERGY (50-350 eV).

M.Koedam.

Physica, Vol. 25, No. 8, 742-4 (Aug., 1959).

The surface of a single crystal of copper was bombarded with normally incident ions of variable energy and the sputtered copper atoms were collected on a parallel glass plate. The distribution of the deposit was examined by its optical transmission and showed preferred directions depending on the orientation of the lattice planes of the crystal.

W.Steckelmacher

PARTICLE ACCELERATORS

537.54

19811 THE CERN SYMPOSIUM 1956. I.

J.B.Adams.

Nuclear Instrum., Vol. 1, No. 1, 2-9 (Jan., 1957).

A general review of the problems of high energy particle accelerators.

537.54

19812 THE CERN SYMPOSIUM 1956. II.

G.F.Von Dardel.

Nuclear Instrum., Vol. 1, No. 1, 10-16 (Jan., 1957).

Review of instrumental aspects concerned with high energy accelerators.

537.54 : 539.17

19813 THE CERN SYMPOSIUM 1956. III.

A.Lundby.

Nuclear Instrum., Vol. 1, No. 1, 17-20 (Jan., 1957).

Review of experimental aspects of high energy physics.

537.54 : 539.17

19814 PROCEEDINGS OF THE CERN SYMPOSIUM 1956.
Nuclear Instrum., Vol. 1, No. 1, 21-30 (Jan., 1957).

Lists the papers presented.

537.54

19815 LIST OF PARTICLE-ACCELERATOR INSTALLATIONS.
G.A.Behman.
Nuclear Instrum., Vol. 3, No. 4, 181-200 (Oct., 1958).

Accelerator installations throughout the world are listed here with the types of particles accelerated and the energy and other characteristics of the machines. Geographical distribution of these accelerators by type of accelerator and country is tabulated, as is the distribution of the machines in the United States according to type of machine and primary activity of the organization.

537.54

19816 LIST OF PARTICLE-ACCELERATOR INSTALLATIONS: ADDENDA AND ERRATA. G.A.Behman.
Nuclear Instrum. and Methods, Vol. 5, No. 2, 129-32 (Aug., 1959).

537.54

19817 PROTECTION AGAINST STRAY RADIATION GENERATED BY ELECTRON ACCELERATORS WITH MAXIMUM ENERGIES UP TO 1 GeV. G.Cortellessa.
R.C. Ist. Super Sanita, Vol. 13, Pt 5, 397-422 (1960). In Italian.

Examines the various types of radiation, the relative intensities, and the attenuation through different materials commonly used for shielding. The cycle of acceleration is divided in three parts: injection, acceleration up to the thresholds for photoneutron production in the more commonly used materials, acceleration to the final energy. Their contributions to the stray radiation field are evaluated. This procedure is used for calculating the shielding of the electron-synchrotron of the National Institute of Nuclear Physics, Frascati.

537.54 : 621.319.339

19818 THE USE OF ELECTROSTATIC GENERATORS AS INJECTORS FOR ELECTRON SYNCHROTRONS.
D.Luckey.
Nuclear Instrum. and Methods, Vol. 5, No. 4, 266-8 (Oct., 1959).

Some experiences with the use of electrostatic generators as injectors for electron synchrotrons at Cornell University and M.I.T. are described. At M.I.T. the injection energy was changed without any other essential modifications to the synchrotron. A factor of ten in intensity has been obtained, along with greater stability. Space charge does not appear to be the limiting mechanism of the beam current.

537.54 : 537.533

19819 DIVERGING ELECTROSTATIC LENSES IN ACCELERATORS. E.Breitenberger.
Nuclear Instrum., Vol. 1, No. 1, 55 (Jan., 1957).

537.54 : 539.23

THIN CARBON FILMS FOR USE WITH ELECTROSTATIC ACCELERATORS. See Abstr. 18415

537.54

19820 MODIFICATION OF AN ENERGY MODULATOR FOR PARTICLE ACCELERATORS.
G.I.Harris, L.Kasturi Rangan, R.Stump and L.W.Seagondollar.
Rev. sci. Instrum., Vol. 31, No. 9, 995 (Sept., 1960).

The circuit of Cranberg et al. (Abstr. 3366 of 1957) has been modified for use in investigating gamma-ray yield curves where the resonances are small, sharp and close together.

J.W.Sturgess

537.54

19821 1 MeV ELECTRON ACCELERATOR AS A SOURCE OF ELECTRONS AND X-RAYS FOR PHYSICOCHEMICAL STUDIES. Y.Cauchois, H.Bruck, P.Ehinger, A.Gazaï and M.Boivin.
J. Phys. Radium, Vol. 20, Suppl. No. 12, 110A-122A (Dec., 1959).
In French.

Describes an equipment built for obtaining intense beams of X-rays and free electrons for research on chemical and physical effects of radiation. The equipment makes use of a high tension cascade generator built for 1.4 MV and a 14 stage accelerating tube working in air coupled to the generator by means of a distributing potentiometer. It has been used for routine work for 2 years and delivers an X-ray dose of the order of 30 000 r/min per mA at a distance of ~ 7.5 cm from the target at 1 MV; it may be run at a 3 kW permanent load.

53

19822 X-RAY DOSIMETRY OF AN ELECTRON ACCELERA USED BELOW 0.2 A AND 1 MV.
Y.Cauchois, A.Bernas and A.Gazaï.
J. Phys. Radium, Vol. 20, Suppl. No. 12, 123A-130A (Dec., 1959).
In French.

Sums up measurements made in order to determine the char teristics of the effective X-ray beam delivered by the accelerato described in the preceding abstract and reports a study of the optimal thickness of the gold target, by means of X-ray dosimetr

537

19823 SOME PROBLEMS IN THE CONSTRUCTION OF AN ELECTRON LINEAR ACCELERATOR.
J.Verhaeghe, V.Vanhuyse, P.Van Leuven and J.Turf.
Meded. K. Vlaamse Acad. Wetensch., Vol. 21, No. 8, 35 pp. (1959)
In Flemish.

Deals with the accelerator at the University of Ghent.

537.

19824 PULSE-SHORTENING IN ELECTRON LINEAR ACCELERATORS. M.G.Kelliher and R.Beadle.
Nature (London), Vol. 187, 1099 (Sept. 24, 1960).

For similar accelerators the current at the onset of pulse-shortening is proportional to $1/f^2$ and to the r.f. power level in the accelerator. The effect occurs first at the high energy end of the guide. If it is a field effect (low fields in the normal mode), it ma be cured by feedback or a constant field design. The latter has be tried successfully. If feedback does not work, higher order spurious r.f. modes may be the cause.

J.W.Sturge

537.54 : 621.38

19825 PULSED BEAM DEFLECTION SYSTEM FOR A LINEAR ELECTRON ACCELERATOR.
M.J.Poole, G.Dean and W.Howe.
Nuclear Instrum., Vol. 2, No. 3, 282-6 (April, 1958).

A method has been developed to permit the simultaneous use two targets with a pulsed linear electron accelerator. A magnet i arranged to deflict the beam onto one or the other target, and this magnet is electronically switched on or off in the interval between the beam pulses. A "countdown" circuit is used to select which pulses shall be directed to each target

537.

19826 THE MOTION OF A STRONGLY RELATIVISTIC ELECTRON IN A LINEAR ACCELERATOR UNDER T ACTION OF RANDOM PERTURBATIONS. K.N.Stepanov.
Zh. tekh. Fiz., Vol. 30, No. 8, 975-80 (Aug., 1960). In Russian.

Expressions are derived for the motion of a strongly relativis electron away from the axis of a linear accelerator due to random perturbing forces, such as might be produced by stray magnetic fields or misalignment of the sections of the accelerator.

D.J.Thoule

537.

19827 THE TRANSIT-TIME FACTOR FOR PROTON LINEA ACCELERATOR. V.S.Kladnitskii.
Zh. tekh. Fiz., Vol. 30, No. 2, 178-85 (Feb., 1960). In Russian.
English translation in: Soviet Physics—Technical Physics (New York), Vol. 5, No. 2, 162-8 (Aug., 1960).

The electrolytic-bath method was used to study the nature of the electric field distribution along the axis of the accelerating syste of a proton linear accelerator, for the cases of a symmetrical gap an of a gap with a klystron-type grid. On the basis of these measurements, the dependence of the transit-time factor T on the repeat length L_n of the accelating system was determined, and the result are compared with the well-known formulae for this factor. It is shown that the effect of penetration of the field beyond the plane of the grid must be taken into account in determining T, especially fo small values of L_n. To increase the efficiency of an accelerating system, it is desirable to make that the ratio of the repeat length the system to the aperture of the drift tubes satifies the condition $L_n/d' \geq 4$.

537.54

828 GENERAL FORMULAS FOR GAP-EXCITED LINEAR DUCTS. J.Van Bladel.
ar Instrum., Vol. 3, No. 1, 52-6 (July, 1958).

quations allowing determination of the electric and magnetic
at each point within a gap-excited metallic duct are derived.
the application to accelerators in mind, formulae are established
e energy and lateral momentum kicks to which a particle is
cted upon crossing the gap region. The configuration where
ap is in a plane perpendicular to the duct's axis is given
al attention.

537.54

829 MAGNETIC MASS ANALYSIS OF A 200 keV ION BEAM FROM A COCKCROFT AND WALTON ACCELERATOR.
tolković, M.Paić, K.Prelec and P.Tomaš.
od. math. -phys. astron. (Zagreb), Vol. 15, No. 1, 61-6 (1960).

Details of a 32° deflection magnet for mass separation of a
eron beam are given. A mass spectrum shows masses from
6 a.m.u., with current between maxima indicating dissociation
ns during acceleration. A.E.I. Research Laboratories

537.54

830 INJECTION OF FAST NEUTRAL BEAMS INTO THE THREE-STAGE TANDEM ACCELATOR.
Rose, R.P.Bastide, A.B.Wittkower, D.L.Webb, C.H.Goldie and
aw.
. sci. Instrum., Vol. 31, No. 10, 1052-3 (Oct., 1960).

An experiment is described in which a beam of fast neutral
ns was injected into the terminal of a tandem accelerator. A
ond tandem was arranged in line with the first. By taking
antage of charge-exchange mechanisms these atoms were
elerated to 15 MeV by a three-stage process.

537.54 : 621.319.339

9831 A VAN DE GRAAFF ACCELERATOR TUBE OF VERY LOW RETROGRADE ELECTRON CURRENT.
.Chick, S.E.Hunt, W.M.Jones and D.P.R.Petrie.
lear Instrum. and Methods, Vol. 5, No. 4, 205-10 (Oct., 1959).

The upper limit to the voltage attained by Van de Graaff
elerators is often set by the flow of electrons towards the
itive terminal of the tube, producing large X-ray fluxes and
ization currents in the gas between the high voltage terminal
the earthed pressure vessel. By designing the internal electrodes of the tube to trap retrograde electrons a voltage of 3.7 MV
been obtained across a nine foot long tube, with immeasurably
all electron currents. The performance of this tube is compared
h that of tubes employing other internal electrode designs.

537.54 : 621.382 : 621.319.339

19832 THE ELECTRON VAN DE GRAAFF IN SEMICONDUCTOR RESEARCH. W.L.Brown.
uclear Instrum. and Methods, Vol. 5, No. 4, 234-41 (Oct., 1959).

A 1 MeV electron Van de Graaff accelerator has been applied to
ndamental semiconductor research. Its versatility as a pulsed
urce of ionization for studying electrical transients in these
aterials and under d.c. operation for introducing atomic defects
to solid lattices has been exploited. These two aspects of the
ccelerator are discussed with examples from experiments in
ermanium.

537.54 : 621.372.829 : 621.384.6

19833 CONSIDERATIONS ON THE CONSTRUCTION OF A HELICAL LINEAR ACCELERATOR FOR PROTONS.
.Müller and J.Rembser.
uclear Instrum. and Methods, Vol. 4, No. 4, 202-12 (May, 1959).
German.

The method of accelerating heavy particles in a helix waveguide
repeatedly suggested in literature has been examined theoretic-
ly in detail. The first part of this article deals with the h.f.
aracteristics of the waveguide that were taken from known investi-
ations based on the Pierce theory. A more accurate examination
the acceleration process for protons shows that the accelerating
ectric field strength on the axis of the helix is strongly reduced
r proton energies $> \sim 30$ MeV, while for proton energies
~ 0.5 MeV the losses in the waveguide considerably increase. In
e case discussed here (acceleration of protons from 1 to 10 MeV)
e optimum vacuum wavelength was found to be ~ 1.5 m. With a
f. source output of 0.5 MW such an accelerator would have a length
~ 12 m, while the diameter of the shield would be 12 cm, the
lume being about $0.15\ \mathrm{m}^3$.

537.54 : 621.375.2

19834 THE 2.5 MW H.F. AMPLIFIER OF THE CERN LINEAR ACCELERATOR. E.Zaccheroni.
Nuclear Instrum. and Methods, Vol. 5, No. 2, 78-89 (Aug., 1959).

Contains a description of the grounded grid amplifier using tuned coaxial lines designed for meeting h.f. power requirements of the Cern linear accelerator. Performance curves are given for this amplifier terminated in a matched load or short circuited. Guidance is given in choosing a suitable working point to prevent damage in the cavity and in the cables due to an external mismatch.

537.54 : 621.384.6 : 681.142

19835 STUDY OF TWO-DIMENSIONAL NON-LINEAR OSCILLATIONS BY MEANS OF AN ELECTROMECHANICAL ANALOGUE MODEL, APPLIED TO PARTICLE MOTION IN CIRCULAR ACCELERATORS. M.Barbier and A.Schoch.
Nuclear Instrum. and Methods, Vol. 5, No. 4, 211-33 (Oct., 1959).

The apparatus consists of a flexible quartz pendulum giving a perfect harmonic oscillation. The pendulum oscillates in a vacuum and hardly any damping takes place. Its surface is rendered conducting by metallization so that electrical forces can be applied to it. If required a permanent non-linear characteristic can be given to the pendulum by this means. It can be excited into resonance by sinusoidal forces, which may or may not depend on its instantaneous position. The properties of the apparatus and experiments made by exciting the pendulum with perturbations at a fixed frequency are described. The performance of the machine was found to be such that one can regard it as a small calculating machine (analogue computer).

537.54 : 621.384.6

19836 A NEW PARTICLE ACCELERATOR. Y.P.Varshni.
Nuclear Instrum., Vol. 1, No. 5, 280-1 (Sept., 1957).

Suggests the construction of spiral dees to overcome difficulties in particle acceleration due to their relativistic increase in mass at high velocities.

537.54 : 621.384.6

19837 ELECTRON MODEL OF A SPIRAL SECTOR ACCELERATOR. D.W.Kerst, E.A.Day, H.J.Hausman, R.O.Haxby, L.J.Laslett, F.E.Mills, T.Ohkawa, F.L.Peterson, E.M.Rowe, A.M.Sessler, J.N.Snyder and W.A.Wallenmeyer.
Rev. sci. Instrum., Vol. 31, No. 10, 1076-1106 (Oct., 1960).

A six-sector spiral ridge fixed field alternating gradient accelerator has been constructed and successfully operated to accelerate electrons from 35 to 180 keV kinetic energy. Acceleration was by betatron action, supplemented by radio-frequency acceleration when desired. The design was based on magnetostatic and orbit computations performed with the Illiac digital computer, and the subsequent performance was found to be in good accord with these computations. Tuning coils permitted variation of the basic parameters about the design value suggested by the computations, so that an experimental investigation could be made concerning the importance of nearby resonances. The theoretical basis of the computational work and the specific results obtained are first described, followed by a resumé of the constructional features and magnetostatic measurements. Tests with the operating model are then reported, comprising a resonance survey, injection studies, perturbation studies, and the use of radio-frequency acceleration. The frequencies of radial and axial-betatron oscillation at the nominal operating point were, respectively, $\nu_x = 1.40$ and $\nu_y = 1.12$, and the resonance survey indicated this operating point to be centrally located within a region of relatively large intensity which was bounded by the resonances $\nu_y = 1.0$, $\nu_x = 1.5$, and (less markedly) $2\nu_y - \nu_x = 1$. Injection from a deflector structure with a thin septum permitted efficient injection to be achieved either by concomitant rapid acceleration of the injected electrons or, alternatively, by use of a time dependent radial electric field applied as a perturbation. Experiments with a protracted injection pulse permitted the observation of phenomena attributable to space charge effects. A suitable frequency-modulation schedule permitted successful acceleration of a substantial fraction of stacked electrons through the transition energy. Appendices describe a modulator, with negative feedback stabilization, to permit protracted injection, a magnetometer, used in the magnetic field measurements, and the essentials of Parzen's theory of perturbations, which was found to account satisfactorily for the results of the perturbation experiments.

537.54 : 621.384.6

19838 REGENERATIVE ACTION IN HIGH ENERGY ACCELERATORS. S.Cohen and A.V.Crewe.
Nuclear Instrum., Vol. 1, No. 1, 31-40 (Jan., 1957).

It is shown that the regenerative method for the extraction of particles from an accelerator can be extended to include machines other than cyclotrons. This is accomplished by the use of modes of radial oscillations in which the regenerative action does not occur on every revolution of the particle about the machine. In particular, that mode of oscillation which allows regenerative action on every other turn is analysed and shown to permit extraction from circular machines whose values of n, where $n = -RH^{-1}(dH/dr)$, lie near 0.75. An extension of the analysis to machines with straight sections and strong focusing machines is included.

537.54

19839 SOVIET ACCELERATORS OF HEAVY CHARGED PARTICLES. A.P.Komar.
Proc. Math. Phys. Soc. Egypt, No. 22, 1-15 (June, 1958).

A survey of orbital accelerators.

537.54

19840 THE CYCLOTRON OF THE "ECOLE SUPÉRIEURE DE PHYSIQUE ET DE CHIMIE", PARIS. M.G.Dupuy.
J. Phys Radium, Vol. 19, Suppl. No. 4, 27A-34A (April, 1958).
In French.

A small cyclotron which has been designed and constructed by students is described. The instrument is used for educational purposes.

537.54 : 621.384.611

19841 THE FOCUSING AND ANALYSING MAGNETS OF THE SACLAY CYCLOTRON.
J.Thirion and J.Saudinos.
Nuclear Instrum. and Methods, Vol. 5, No. 3, 165-9 (Sept., 1959).
In French.

Two strong gradient magnets deflect and refocus the beam of the cyclotron in both directions. The beam is then analysed by a double focusing magnet which gives a definition in energy of 1.5/1000 for 2 mm slits. This analyser can also be used for analysing secondary particles.

537.54 : 621.384.611

19842 THE PRETORIA CYCLOTRON.
J.J.Burgerjon, S.J.du Toit and C.A.J.Kritzinger.
Nuclear Instrum., Vol. 3, No. 6, 323-35 (Dec., 1958).

A brief technical description of the Pretoria fixed frequency cyclotron is given. It is a 112 cm machine which at present accelerates internal deuteron beams of 200 microamperes to 15 MeV. Interesting features are a double ion source and automatic target removal and despatch mechanism.

537.54

19843 A METHOD FOR THE PREPARATION OF CYCLOTRON TARGETS OF RARE-EARTH OXIDES BY ELECTROPHORESIS. S.Bjørnholm, P.Dam, H.Nordby and N.O.R.Poulsen.
Nuclear Instrum. and Methods, Vol. 5, No. 3, 196-8 (Sept., 1959).

537.54 : 539.12

19844 FINE TIME-STRUCTURE OF BEAMS FROM THE BIRMINGHAM PROTON SYNCHROTRON.
N.E.Booth and G.W.Hutchinson.
Nuclear Instrum., Vol. 1, No. 2, 80-5 (March, 1957).

The radio-frequency time-structure of beams scattered from internal targets in the Birmingham proton synchrotron has been investigated using a delayed self-coincidence technique. The degree of bunching of all the beams commonly used in counter experiments has been investigated and methods of increasing the burst length and destroying the radio-frequency structure are discussed.

537.54

19845 TWO TARGET OPERATION OF A PROTON—SYNCHROTRON. S.J.Goldsack.
Nuclear Instrum., Vol. 1, No. 2, 90-1 (March, 1957).

537.54

19846 GAS SCATTERING IN A STRONG FOCUSING SYNCHROTRON. M.D.Kostin.
Nuclear Instrum. and Methods, Vol. 4, No. 2, 99-102 (March, 1959).

Strong focusing synchrotron dynamics as they apply to gas scattering are discussed. The gas scattering transport equation which includes the effects of adiabatic damping is formulated. A practical method of obtaining the solution is developed.

537.54 : 621.384

19847 FOCUSSING OF THE SYNCHROTON SCATTERED-OU BEAM. H.B.Van der Raay.
Nuclear Instrum., Vol. 1, No. 6, 351-3 (Dec., 1957).

A means of focusing the scattered-out beam of the Birmingha proton synchrotron by modifying the magnetic fringing field is ou lined. The beam is brought to a spot focus of about 20 cm^2 at a distance of 5 meters from the exit port and has a mean intensity of 5×10^3 particles/cm^2 per pulse.

537.54 : 621.318

19848 FIELD STABILIZATION IN A D.C.—A.C. EXCITED MAGNET OF A SYNCHROTRON.
G.Ghigo and I.F.Quercia.
Nuclear Instrum., Vol. 1, No. 2, 57-61 (March, 1957).

The shape of the magnetic field of an electron-synchrotron is quite critical at injection. If the machine is fed with an a.c. curr and with a bias d.c. current, the shape of the field at injection is quite sensitive to the values of the peak a.c. current and of the d. current. A device is described that is sensitive to the difference between peak a.c. and d.c. current and which keeps this differenc constant by controlling the value of the d.c. current. The apparat was applied to model magnets of the 1 GeV Italian electron-synch tron, and is planned for controlling the supply of the synchrotron.

537

19849 THE CORRECTION CIRCUITS OF THE "SATURNE" SYNCHROTRON. G.Neyret and J.Parain.
Nuclear Instrum. and Methods, Vol. 5, No. 4, 259-65 (Oct., 1959).
In French.

The main defects of the magnetic field concern the index valu the position of the magnetic median plane and the residual ripple. For each of the defects, the methods of correcting are explained well as their practical realization and some experimental results are given.

537.54 :

19850 MAGNETIC MEASUREMENTS ON THE CORNELL ALTERNATE GRADIENT SYNCHROTRON.
E.Malamud and A.Silverman.
Nuclear Instrum. and Methods, Vol. 4, No. 2, 67-78 (March, 1959

A brief description of the synchrotron magnet is followed by summary of the factors leading to a choice of field gradient, and description of the pole tip design. Measurements of the synchrot field gradients at low, medium and high fields are described. Th medium and high field gradients are measured using a rotating c magnetometer. The gradients at injection time have been determined by two independent methods: (1) using the electron beam i self to find the radial and vertical focal points; and (2) using peak ing strips to make zero time measurements. The results of thes measurements and also the determination of the magnetic lens boundaries are summarized.

537.54 : 538.1 : 621.384.612 : 621.31

19851 THE TESTING OF THE ELECTROMAGNET SEGMEN OF THE SACLAY SYNCHROTRON.
G.Bronca, H.Bruck, J.Hamelin, G.Neyret and T.Bolzinger.
Nuclear Instrum., Vol. 1, No. 3, 123-32 (May, 1957). In French.

After a brief description of the synchrotron magnet and the effects of the field inhomogeneities, the principle of the stacking procedure to minimize these effects is described. A practical w of determining the azimuthal location of the segments is develope Finally an estimate is made of the gain of the operation with resp to a random distribution of the segments.

537

19852 SPIRAL RIDGE CYCLOTRON PARTICLE DYNAMICS APPLIED TO CONVERSION OF THE HARWELL SYNCHROCYCLOTRON. N.M.King and W.Walkinshaw.
Nuclear Instrum., Vol. 2, No. 4, 287-98 (May, 1958).

A theoretical design study for conversion of the Harwell synchrocyclotron to spiral ridge operation is outlined. Effects du to non-linearities in the dynamics have a major influence on the design. The initiation of large radial betatron oscillations at the centre of the machine could have serious consequences, and expe mental model studies are now in progress to examine the proble Apart from this, the suggested conversion should be feasible with careful design and construction.

537.54 : 621.384.612

9853 SOME FEATURES OF REGENERATIVE REFLECTION AND THEIR APPLICATION TO THE HARVARD CHROCYLOTRON.

alame, P.F.Cooper, Jr, S.Engelsberg, G.L.Gerstein, .Koehler, A.Kuckes, J.W.Meadows, K.Strauch and R.Wilson.
lear Instrum., Vol. 1, No. 4, 169-82 (July, 1957).

The regenerative deflector system applied to the Harvard hrocyclotron is described. The theory of LeCouteur has been nded to include the initial radial oscillations, and it is shown, theoretically and experimentally, that only partial mono- omatization of the beam occurs during regeneration. However, possible to internally limit the energy width of the regenerated n at the expense of intensity. The theory is in good accord with eriment. The application of these results to the production of ntense external proton beam and more monoenergetic neutron polarized proton beams is described.

537.54

9854 THE TUNINGFORK FREQUENCY MODULATOR OF THE CERN SYNCHRO-CYCLOTRON. I. GENERAL SIGN.

F.Krienen.
lear. Instrum. and Methods, Vol. 5, No. 5, 280-91 (Nov., 1959).

The report deals with the 600 MeV synchro-cyclotron, which ne into operation in August 1957. The intricate position of the dulator in the accelerator as a whole, required the development he principle of scaling. Basic design considerations are put ward. These considerations initiated an experimental pro- mme, which in its turn verified and corrected the starting nts. Suitable mechanical and electrical analogues are derived, ch in many respects clarify the nature of the problem. The trol and initial operation of the system are described and ssible improvements are mentioned.

537.54

19855 THE TUNINGFORK FREQUENCY MODULATOR OF THE CERN CYNCHRO-CYCLOTRON. II. MECHANICS TUNINGFORK.

F.Krienen.
clear Instrum. and Methods, Vol. 5, No. 5, 292-9 (Nov., 1959).

An analysis is given of the motion of a tuningfork, whose prongs e tapered. A suitable expression for the resonance frequency d the stresses in the material is obtained, in fair agreement th experiment. The application of aluminium was shown to be t inferior to steel. An expression for the longitudinal motion, portant for the driving system, is obtained. The higher modes vibration are discussed qualitatively together with the possible fects on the performance.

537.54 : 621.384.611

19856 EFFICIENT BEAM EXTRACTION FROM A SYNCHRO-CYCLOTRON AT n = 1.

S.Suwa, J.Sanada, T.Karasawa, Suzuki, H.Ogawa, H.Yamaguchi, Y.Saji, S.Kikuchi, H.Kumagai, ayashi, K.Matsuda and K.Nisimura.
clear Instrum. and Methods, Vol. 5, No. 3, 189-93 (Sept., 1959).

With an electrostatic deflector placed at $n = 1$ (the point of aximum Br), about 50% of the internal beam (inside $n = 0.2$) of the 0 cm synchrocyclotron could be extracted, and most of the tracted beam was confined within a 2.5 cm diameter area at the nk exit by inserting a magnetic channel acting as a focusing lens. ne homogeneity of the magnetic field is essential for this method beam extraction. The configuration and position of the ion source, d the dee bias voltage were found to affect the transmission of e beam through $n = 0.2$ to $n = 1$. Under the optimum conditions, -80% of the beam inside $n = 0.2$ reached $n = 1$.

537.54

19857 THE VERTICAL MOTION OF PARTICLES THROUGH THE REGENERATIVE BEAM EXTRACTOR OF A YNCHROCYCLOTRON.

K.J.Le Couteur.
uclear Instrum., Vol. 1, No. 6, 343-4 (Dec., 1957).

In a regenerative beam extractor, the vertical motion of rticles approaching the regenerator is shown to be correlated out the line $\dot{Z} = -\frac{1}{2}TZ$; this correlation permits efficient design the magnetic channel.

537.54 : 621.384.6

19858 A SYNCHRO-CYCLOTRON PULSE SIMULATOR FOR TESTING ELECTRONIC CIRCUITS.

.Fazzini, G.Fidecaro and H.Paul.
uclear Instrum. and Methods, Vol. 5, No. 3, 156-60 (Sept., 1959).

An electronic pulse generator is described that can be used to test electronic circuits under conditions of alternating high and zero counting rate similar to those existing at a synchro-cyclotron. It consists of a gated oscillator and a pulse sharpener.

537.54

19859 STABILIZATION OF THE γ-RADIATION INTENSITY IN BETATRONS AND SYNCHROTRONS.

G.F.Mikheev and N.N.Chernov.
Zh. tekh. Fiz., Vol. 30, No. 1, 37-40 (Jan., 1960). In Russian.
English translation in: Soviet Physics—Technical Physics (New York), Vol. 5, No. 1, 33-6 (July, 1960).

A method of intensity stabilization is described which depends on feedback between the intensity and the time of the high-voltage injection pulse. On the synchrotron used, at 90% maximum current, the intensity remained constant to 1% for long periods.

J.W.Sturgess

537.54

19860 INVESTIGATION OF THE ELECTRON DISTRIBUTION IN THE VACUUM CHAMBER OF A BETATRON.

S.G.Denisov, D.P.Ivanov, A.P.Komar and Yu.S.Korobochko.
Zh. tekh. Fiz., Vol. 30, No. 1, 31-6 (Jan., 1960). In Russian.
English translation in: Soviet Physics—Technical Physics (New York), Vol. 5, No. 1, 28-32 (July, 1960).

The distribution was investigated using a probe. The greatest density was found in the median plane of the betatron in a layer of about half the chamber height. The beam spreads laterally and after two or three revolutions occupies the whole width of the chamber. These results were confirmed by observing the intensity of the γ ray yield from captured electrons striking a probe.

J.W.Sturgess

537.54

19861 ENERGY CONTROL OF A 31 MeV BETATRON.

D.Jamnik.
Nuclear Instrum., Vol. 1, No. 6, 324-8 (Dec., 1957).

The article describes circuitry for the energy control of the 31 MeV Brown—Boveri type betatron and gives the results of the energy calibration. Except for supplementary circuits required for the above type betatrons, normal techniques are used: the electron orbit is expanded at a given value of the magnetic flux, defining the electron energy. A better measure of the flux is achieved by the use of an electronic voltage integrator. The arrangement enables a stabilization of about ±5 keV at 17 MeV for rather wide fluctuations of the magnet supply frequency and voltage. The energy calibration performed with thresholds and breaks in the excitation curves for (γ, n) reactions in copper, oxygen and carbon shows excellent linearity of the relationship between the measured flux and the maximum energy of the X-ray spectrum. The positions of the breaks in the excitation curves found in this work agree very well with the published results.

537.54

19862 MEASUREMENT AND AUTOMATIC CONTROL OF THE ENERGY OF A 31 MeV BETATRON.

U.Farinelli, F.Ferrero and R.Malvano.
Nuclear Instrum., Vol. 3, No. 4, 218-22 (Oct., 1958).

A simple method to control the energy of a betatron is proposed. It compares a signal proportional to the average e.m.f. during the acceleration period derived from a measuring loop to a suitable reference voltage, and derives an error signal which operates small changes in the expansion time.

MAGNETISM

(The magnetic properties of solids are included under Solid-State Physics; similarly for Liquid State and Gaseous State)

538

19863 THE ELECTRONICS OF THE "REPTOGRAPH" AUTOMATIC RECORDER FOR THE PHENOMENA OF MAGNETIZATION ACCOMMODATION.

G.Bonnet and R.Gariod.
J. Phys. Radium, Vol. 19, Suppl. No. 12, 160A-166A (Dec., 1958).
In French.

See Abstr. 12663 of 1960 for a general description of the apparatus and its applications. The present article deals with the purely electronic aspect of the recorder.

538

19864 A MODIFICATION OF THE NUCLEAR RESONANCE METHOD FOR MEASUREMENTS OF NON-UNIFORM MAGNETIC FIELDS. C.H.Vincent, W.G.King and J.B.Rowles.
Nuclear Instrum. and Methods, Vol. 5, No. 4, 254-8 (Oct., 1959).

It is practicable to obtain accurate measurements of magnetic field intensity in non-uniform fields by the nuclear resonance method with the aid of a set of current-carrying coils which neutralize the field gradient. For use on an electromagnet, a method of controlling the compensating currents by reference to the magnet current is described. This method simplifies the adjustment of the compensating currents. Field gradients up to 150 gauss/cm may be neutralized by the equipment described, which has been used so far in fields ranging from 2 to 10 kG. In the instruments constructed, it has only been necessary to compensate for variations of the field along the two axes normal to the field itself. However, it should be possible to compensate for variation along the axis parallel to the field as well, and the coil arrangement required for this is also described.

538 : 621.317.42

19865 A DEVICE FOR THE PRECISION MEASUREMENT OF AN INHOMOGENOUS MAGNETIC FIELD. G.Bäckström.
Nuclear Instrum., Vol. 1, No. 5, 253-8 (Sept., 1957).

A generator device has been constructed for measuring the field of a β-spectrometer, having a gradient of 1% per cm and a field range 10-300 gauss. A sensitivity of 1 : 10^6 has been obtained.

538 : 621.384.612 : 621.317.42

19866 ELECTRONIC APPARATUS FOR THE MEASUREMENT OF DYNAMIC MAGNETIC FIELDS. I.F.Quercia.
Nuclear Instrum., Vol. 3, No. 5, 292-7 (Nov., 1958).

An apparatus is described which reproduces with a staircase voltage waveform a magnetic field rising between 0 and about 120 gauss. The device is well suited for the measurement of the instantaneous value of the magnetic field in the gap of an electron synchrotron. It consists of a peaking strip magnetic probe, and an electronic apparatus.

538

19867 FAST MAGNETIC FIELD SWEEP.
G.W.Barton, Jr, L.F.Tolman and R.E.Roulette.
Rev. sci. Instrum., Vol. 31, No. 9, 995-7 (Sept., 1960).

A circuit is described to sweep the field of an electromagnet in a rapid controlled fashion. Field sweeps of about 1000 G up to a maximum of 16 500 G are accomplished at rates of about 1 c/s.

D.Walsh

538 : 621.317.411

19868 A SIMPLE FIELD DETECTOR FOR A D.C. PERMEAMETER. C.Q.Adams.
Rev. sci. Instrum., Vol. 31, No. 10, 1119-20 (Oct., 1960).

A two-core flux-gate magnetometer is employed in a simple balanced bridge circuit as the d.c. field detector of a single strip permeameter. The sensitive magnetometer and simple bridge circuit eliminated the necessity of the complex filter and selective amplifier used in earlier systems and allows operation independent of oscillator frequency stability. The H-measuring system is designed to measure fields from 1 mOe to about 10 Oe with a sensitivity of ≅25 μA/mOe. Economy and simplicity of construction, circuitry, and operation are its chief advantages.

538

19869 A NULL METHOD FOR THE MEASUREMENT OF THE TEMPERATURE DEPENDENCE OF MAGNETIC MOMENT. G.Atanasiu and S.Pătrașcu.
Stud. Cercetari Fiz., Vol. 10, No. 1, 7-17 (1959). In Roumanian.

538

19870 TRANSDUCER-OPERATED BALANCE FOR MAKING MAGNETIC SUSCEPTIBILITY MEASUREMENTS.
W.K.Chen, F.B.Koch and J.M.Siversten.
Rev. sci. Instrum., Vol. 31, No. 10, 1157-8 (Oct., 1960).

538 : 538.56

19871 HIGH STABILITY PROTON RESONANCE MAGNETIC FIELD REGULATION WITH AN ELECTRONIC INTEGRATOR. W.Müller-Warmuth and P.Servoz-Gavin.
Nuclear Instrum. and Methods, Vol. 4, No. 2, 90-8 (March, 1959). In German.

The design, construction and performance of a precision magnetic field stabilizer for electromagnets supplied with line vol age is described. It includes a current stabilizer and a two-loop servosystem using nuclear magnetic resonance. One loop acts up a correcting coil, the other drives the current stabilizer through a electronic integrator. Due to the second loop, the apparatus is a type 1 servosystem which practically cancels the steady-state err and keeps the velocity error constant, allowing very linear sweep the field. The over-all system is studied in terms of servomechan ism theory. The final time stability is 10^{-7}. Together with synchr nized autodyn-detector, this system affords a useful and flexible w to control, measure, and sweep magnetic fields from a standard frequency source.

538 : 621.317.

19872 COUNTER TORQUE QUARTZ FIBER ADAPTATION OF THE CURIE—CHÉNEVEAU TYPE MAGNETIC BALANCE. M.C.Day, L.D.Hulett and D.E.Willis.
Rev. sci. Instrum., Vol. 31, No. 10, 1142-5 (Oct., 1960).

A mechanically simple magnetic balance having sufficient sensitivity to measure diamagnetic susceptibilities has been developed using a permanent magnet. Its operation is based on the twisting of a quartz or Vycor fibre in a direction such as to overcome the effects of the magnetic field. The magnetic field strengt is dependent on the position of the magnet with respect to the samp and can be varied by using different magnet settings.

538 : 621.318.3 : 621.316.7

19873 A PARTICULARLY SIMPLE CURRENT STABILIZER OF THE HIGHEST GRADE FOR ELECTROMAGNETS. B.Berkeš.
Nuclear Instrum., Vol. 3, No. 5, 260-4 (Nov., 1958). In German.

A type of current stabilizer for electromagnets used in nuclea magnetic resonance experiments is described. A high dynamic stability (1 : 20 000 at 1.6 A, input voltage variations ±5%, load variations 10%) is obtained using a diode with a tungsten filament, which represents a stage with an extremely high amplification in the feedback loop. A high thermal stability is provided by means this diode since it is practically insensitive to normal room tempe ature changes. In spite of a relatively high time constant of the heater filament, in series with the inductance of the magnet, it is possible to obtain a fast response to sudden changes of input voltag Measurements were made with a precision potentiometer of an accuracy 1 : 100 000 and results agree within 20% with theoretical considerations.

538 : 537.

MAGNETIC MEASUREMENTS ON THE CORNELL ALTERNAT GRADIENT SYNCHROTRON. See Abstr. 19850

538.1 : 537.54 : 621.384.612 : 621.318

THE TESTING OF THE ELECTROMAGNET SEGMENTS OF THE SACLAY SYNCHROTRON. See Abstr. 19851

538.

19874 NOTE ON PERTURBATION OF A UNIFORM MAGNETIC FIELD BY A CUBE OF MAGNETIC MATERIAL. F. Partovi.
I.B.M. J. Res. Developm., Vol. 4, No. 3, 357-8 (July, 1960).

Evaluates the magnetic field in the vicinity of a rectangular parallelepiped of high permeability placed in a uniform field. For a first approximation the parallelepiped is assumed to be magnetized in the direction of the uniform field. Experimental measurements confirm that this is a good approximation. A second approximation is also derived.

A.E.I.Research Laborator

53

19875 HIGH MAGNETIC FIELDS.
S.Berglund.
Nuclear Instrum. and Methods, Vol. 4, No. 5, 386-90 (June, 1959).

A brief introduction is given to the literature concerning desig and construction of coils producing high magnetic fields (i.e. up to 100 kG and more).

538.1 : 621.373.

19876 AN ARRANGEMENT FOR PRODUCING PULSED, STEADY AND STRONG MAGNETIC FIELDS.
J.Durant, O.Klüber and H.Wulff.
Z. angew. Phys., Vol. 12, No. 9, 393-5 (Sept., 1960). In German.

It is first shown how a length of artificial line may be used to produce short pulses of current. The termination of the line in an

g winding of an electromagnet enables a pulsed magnetic
be produced, provided the inductance of the winding is less
e half of the inductance of the artificial line per unit section.
en shown that if a reasonable number of sections are used
line to produce a pulse of satisfactory shape the energy in
ld is only a small fraction of the total energy fed into the
The efficiency of the system is much improved if the
ing to the line is carried out in two stages and an auxiliary
tor is used in such a way that switching occurs when the
erivative of current is zero. A practical circuit is given
will produce a field of 50 kG for 2 msec in a volume of 30 cm^3.
S.C.Dunn

538.1 : 539.2 : 537.3

77 THE PRODUCTION OF HIGH, PULSED MAGNETIC FIELDS. P.Cotti.

gew. Math. Phys., Vol. 11, No. 1, 17-32 (Jan. 25, 1960). In
an.

he design of an apparatus using capacitor discharges is dis-
d. Efficiency, heating and strength are investigated. The calcu-
s are compared with experimental data on coil types producing
00 A/cm (400 000 Oe) for 1 ms in a volume of 0.5 cm^3 and
A/cm (100 000 Oe) for 100 ms in 10 cm^3. Results of magneto-
tance measurements on copper to 260 000 A/cm (325 000 Oe) at
nitrogen temperature and to 160 000 A/cm (200 000 Oe) at
helium temperature are given. In a Kholer diagram these
ts are in agreement with work by Chambers (Abstr. 6195 of
on purer specimens in lower fields.

538.1 : 621.318.12

878 MAGNETIC LOSSES IN CORES OF VARIOUS SHAPES. D.S.Robertson and D.Elliott.

ar Instrum. and Methods, Vol. 5, No. 3, 133-41 (Sept., 1959).

The shape of magnetic cores determines the distribution of
within them, so that it is reasonable to expect magnetic losses to
function of core shape. In this paper, hysteresis and eddy
ent losses are calculated for the following cases: rectangular
s; rectangular cores with air gaps; ring cores. The results show
a square core is only slightly inferior to an equivalent ring
. Although an air gap is shown to be of value in relieving the
concentrations of loss near the inside corners of the core, it is
to have little effect on the total loss. Similarly, the "rounding
of inside corners is shown to be of limited value. The results
e analysis are checked experimentally.

538.1 : 621.318.57

19879 ON OPTIMUM FIELD HOMOGENEITY OF HIGH ENERGY COIL MAGNETS.

Ingarden and J.Michalczyk.

. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 8, No. 5,
-24 (1960).

The problems of designing high-energy magnet coils of optimum
ensions to satisfy these three criteria: (1) largest possible
, (2) optimum homogeneity, (3) smallest coil size and weight,
discussed in general. The particular case of a split solenoid
onsidered, and optimum dimensionless parameters are derived.
S.A.Ahern

ELECTROMAGNETISM
MAGNETOHYDRODYNAMICS

538.3

19880 CORRELATION THEORY OF STATIONARY ELECTROMAGNETIC FIELDS. I. THE BASIC FIELD EQUA-
NS. P.Roman and E.Wolf.

vo Cimento, Vol. 17, No. 4, 462-76 (Aug. 16, 1960).

In recent papers a class of second order correlation tensors
introduced and certain differential equations which govern their
pagation were postulated. These correlation tensors, which may
regarded as natural generalizations of functions used in the
lysis of partially coherent optical wavefields, characterize the
relations which exist between the electromagnetic field vectors
ny two points in the field, at any two instants of time. In the
sent paper a derivation of the basic differential equations is
sented; and it is shown that the two sets into which the equations
rally split are not independent, but in fact follow from each other
a consequence of certain symmetry properties which the correla-
tensors exhibit.

538.3

19881 CORRELATION THEORY OF STATIONARY ELECTROMAGNETIC FIELDS. II. CONSERVATION LAWS.

P.Roman and E.Wolf.

Nuovo Cimento, Vol. 17, No. 4, 477-90 (Aug. 16, 1960).

Two new second order space-time correlation tensors $\mathscr{W}_{jk}(x_1, x_2, \tau)$ and $\mathscr{S}_{jk}(x_1, x_2, \tau)$ are introduced, which are simple linear combinations of the correlation tensors discussed in Pt I (see preceding abstract), (x_1, x_2 are position vectors of two points and τ a time delay). These new tensors are intimately related to certain generalizations of the (time averaged) energy density and the energy flow vector. Differential equations which $\mathscr{W}_{jk}$ and $\mathscr{S}_{jk}$ satisfy in free space are derived, and from them four new conservation laws are deduced. In the limit $x_1 \to x_2$, $\tau \to 0$ two of these laws reduce to the usual laws (in time averaged form) for the conservation of the energy and the momentum in an electromagnetic field. The other two laws reduced only to trivial identities in this limit, so that they have no analogy in the framework of the usual theory.

538.3

19882 ON THE FIELD--MATTER INTERACTION IN CLASSICAL ELECTRODYNAMICS. I.

I.Prigogine and B.Leaf.

Physica, Vol. 25, No. 11, 1067-79 (Nov., 1959).

The problem of the interaction between a classical charged particle and its self-field is treated by a perturbation method (Abstr. 121 of 1957) based on the Liouville equation. With this formalism one can represent the behaviour of the system (field + matter) with a single linear partial differential equation. To the order e^2, the only modification introduced by the self-field, in the absence of external forces, is a re-normalization of the mass. The method is thus similar to those of current field theories, but it is claimed that it may present advantages in certain applications, particularly for the study of non-Hamiltonian problems. As an example, it is applied to the motion of a charged particle in a black body, where the mass depends on the temperature, thus allowing in principle a separation between electromagnetic and non-electromagnetic mass.
L.Pincherle

538.3

19883 A REFORMULATION OF THE BORN—INFELD ELECTRODYNAMICS. P.A.M.Dirac.

Proc. Roy. Soc. A, Vol. 257, 32-43 (Aug. 23, 1960).

The electrodynamics proposed by Born and Infeld in 1943 differs from the Maxwell electrodynamics for very strong fields and gives a finite total energy for the field around a point charge. At that time not much was known about the dynamical theory of fields, and recent developments of this subject enable one to give a better formulation of the Born—Infeld theory. The basis is a comprehensive action principle that determines both the field equations and the equations of motion of charged particles. From this action principle a Hamiltomian formulation is obtained, the various Hamiltonian constraints being worked out. The classical theory is found to be completely satisfactory, but difficulties arise with the passage to the quantum theory, which appears to be insoluble with present methods of quantization.

538.3

19884 ON THE FOUNDATIONS OF ELECTRODYNAMICS. I. G.Zin.

R.C. Accad. Naz. Lincei, Vol. 28, No. 2, 183-8 (Feb., 1960). In Italian.

From considerations of the work done in the slight deformation of one of two neighbouring circuits in a uniform medium, it is concluded that the interaction between two elements of current can be represented as a force and a couple. This result is used to derive expressions for the force and couple exerted on a current element by an external magnetic field.
R.A.Newing

538.3 : 550.3

19885 THE INDUCTION OF ELECTRIC CURRENTS IN NONISOTROPIC AND NONUNIFORM THIN SPHERICAL SHELLS AND ITS APPLICATION TO A PROBLEM IN GEOMAGNETISM. N.O.M.Hanna.

Proc. Math. Phys. Soc. Egypt, No. 22, 101-8 (June, 1958).

The paper consists of two parts. In the first, any nonisotropic, nonuniform spherical shell is considered which is placed in a non-conducting medium whose permeability is unity. A varying magnetic field is assumed, external to the shell and surrounding it. An equation is deduced which is satified by the reduced currents in this then spherical shell. In the second part, the results obtained are applied to a study of the effect of taking zero conductivity along the direction of the parallels in a nonisotropic, uniform, ionospheric spherical shell. This is shown to produce: (1) no current flow, (2) no Θ component of the electric field, (3) a polarization field E_ϕ in the ϕ direction. Spherical polar coordinates are used throughout.

538.3

19886 ENERGY RADIATED BY A POINT CHARGE IN HYPERBOLIC MOTION. L.Leonard.

Bull. Soc. Roy. Sci. Liege, Vol. 29, No. 11-12, 330-5 (Nov.-Dec., 1960). In French.

A statement made by Drukey (Abstr. 386 of 1950) is examined. In contrast to Drukey's result, it is shown that there is no energy radiated in such motion.

538.3 : 530.12

PURE RADIATION IN THE PRESENCE OF ELECTROMAGNETIC INDUCTION. See Abstr. 18931

538.3 : 539.18

19887 AN EXPERIMENTAL METHOD FOR DISTINGUISHING THE DIFFERENT FORMS OF MULTIPOLE RADIATION IN THE X-RAY SPECTRUM. I. GENERALIZATION OF THE RECIPROCITY THEOREM FOR ELECTROMAGNETIC MULTIPOLE SOURCES. A.Rubinowicz.

Acta. phys. Polon., Vol. 19, No. 1, 21-40 (1960). In German.

The Lorentz reciprocity theorem for electric and magnetic fields is generalized for multipole fields of any order. The generalized form can be applied to the solution of more complex problems where the solution for the corresponding dipole problem is known.
A.E.I. Research Laboratory

538.3

19888 CONDUCTING OR POLARIZABLE MEDIA IN MOTION. [Milieux conducteurs ou polarisables en mouvement].

H.Arzeliès with the collaboration of J.Henry.

Paris: Gauthier-Villars (1959) xliv + 347 pp. (Travaux de l'Institut Scientifique Chérifien Série Sciences Physiques No. 5). In French.

The fourth volume of a series on relativity and gravitation. The first part of the book is concerned with the uniform motion of an isotropic medium and contains a detailed exposition of the Minkowski theory both in 3-dimensional and in 4-dimensional formulations; there are applications to conductors and para-electric and paramagnetic media moving in vacuo. In part II, general considerations of equivalence and covariance are used to extend the theory to an arbitrary frame of reference. The 3-space metric is taken to be $\gamma_{ij} = g_{ij} - g_{i4}g_{j4}/g_{44}$, and the electromagnetic equations are expressed in terms of 3-space tensors and vectors. Careful attention is given to the transformation properties of intensities and inductions; electric induction is found to depend upon the metric and the magnetic induction and polarization as well as upon the electric intensity. Application to a rotating frame of reference is considered and, in two final chapters, there is a full and detailed discussion of uniformly rotating spherical and cylindrical magnets. The case of an anisotropic medium is considered in an appendix. There are useful historical notes and bibliographies. R.A.Newing

538.3 : 523.877

19889 MAGNETO-GRAVITATIONAL INSTABILITY OF A COMPRESSIBLE NON-UNIFORM MEDIUM IN NON-UNIFORM ROTATION. A.G.Pacholczyk.

R.C. Accad. Naz. Lincei, Vol. 28, No. 3, 357-63 (March, 1960). In Italian.

It is assumed that the fluid is perfectly conducting, that both unperturbed and perturbed variables have cylindrical symmetry, and that the unperturbed velocity and magnetic field are purely azimuthal. Stability criteria are obtained for the cases where the unperturbed density is (a) uniform and (b) proportional to the square of the magnetic field and therefore to a certain negative power of distance from the axis of symmetry. O.Penrose

538.3 : 523.11 : 550.3

19890 COSMICAL MAGNETIC FIELDS AND THE HYDROMAGNETIC THEORY OF THE DYNAMO EFFECT.

S.Colombo.

Cahiers de Phys., Vol. 14, 55-67 (Feb., 1960). In French.

A review is given of current knowledge of the magnetic fields of the earth, sun, sunspots, stars and galaxies. Some explanations of these are given, in particular the dynamo effect. An analytic stu
is made of the dynamo effect. A.H.Gab

538.3 : 523

MAGNETO-HYDROSTATICS OF STELLAR ATMOSPHERES. See Abstr. 18853

19891 A CLASS OF PLANE PROBLEMS OF MAGNETO-HYDRODYNAMICS. K.A.Lur'e.

Zh. tekh. Fiz., Vol. 30, No. 6, 736-8 (June, 1960). In Russian.

Two-dimensional flow of a conducting inviscid fluid round an
obstacle in a magnetic field perpendicular to the flow is consider
The velocity field, being the same as in a corresponding non-magnetic problem, is regarded as known, and it is shown how the magnetic field can be determined with the help of a conformal tran
formation. O.Penr

53

19892 EXACT SOLUTION FOR A PROBLEM IN MAGNETO-HYDRODYNAMICS. Ya.S.Uflyand and I.V.Chekmarev

Zh. tekh. Fiz., Vol. 29, No. 11, 1412-14 (Nov., 1959). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 4, No. 11, 1301-3 (May, 1960).

The problem is that of the motion of a conducting fluid betwe
two plane parallel plates in a transverse magnetic field, when the plates are moved together with a uniform velocity. A.H.Gabr

53

19893 COMMENTS ON "LAMINAR STEADY-STATE MAGNE TOHYDRODYNAMIC FLOW IN AN ANNULAR CHANNEL". J.N.Kapur and R.K.Jain.

Phys. of Fluids, Vol. 3, No. 4, 664-5 (July-Aug., 1960).

The authors point out an error and some misprints in a pape
by Globe (Abstr. 9864 of 1959), and also criticize Globe's argume
leading to the relation $\partial H_z/\partial z \doteq 0$. The final results of Globe's p
are unaffected. O.Penr

53

19894 COMMENTS ON LETTER BY J.N.KAPUR AND R.K.JAIN. S.Globe.

Phys. of Fluids, Vol. 3, No. 4, 665-6 (July-Aug., 1960).

In the light of Kapur and Jain's criticisms (see preceding abstract), the author concludes that the results of his original paper (Abstr. 9864 of 1959) are valid provided some additional symmetry requirement, implying $\partial H_z/\partial z = 0$, is imposed on the magnetic field. O.Penr

538

19895 THE BOUNDARY LAYER OF AN INCOMPRESSIBLE FLUID WITH PERIODIC MOTION MAGNETOHYDRO DYNAMICS. M.Katagiri.

Mem. Fac. Engng. Nagoya Univ., Vol. 11, No. 1-2 137-42 (Nov.,

The periodic boundary layer flow of an electrically conducti
viscous and incompressible fluid in a uniform magnetic field is considered. It has been shown that the viscous effect is reduced due to the effect of the magnetic field and that the periodic free stream does not induce a secondary flow at a large distance fro
the body. M.Has

5

19896 UNSTEADY FLOW OF LIQUID METAL IN AN ELEC MAGNETIC INDUCTION PUMP.

Ya.Lielpeter [J.Lielpēteris].

Latv. PSR Zinat. Akad. Vestis No. 2 (151), 79-86 (1960). In Rus

This paper treats theoretically the motion of a conducting fl
which is accelerated from rest by a travelling magnetic field. T
equations of motion are solved exactly for the case when the flui
between two infinite plates and experiences a constant pressure gradient. The corresponding problem for a pump with an externa
load is also treated, using the hydraulic approximation, both for laminar and turbulent flow. O.Penr

19897 A MECHANICAL HALL EFFECT. L.J.F.Broer, L.A.Peletier and L.van Wijngaarden.

Appl. Sci. Res. B, Vol. 8, No. 3, 259-60 (1960).

Equations are set up for the flow of gas between conducting plates in a magnetic field, when a force parallel to the plates is applied to the gas. It is shown that a pressure gradient analogou
to the Hall effect is set up. A.H.Gab

538.3

9898 FLOW OF AN ELECTRICALLY CONDUCTING FLUID PAST A POROUS FLAT PLATE IN THE PRESENCE OF RANSVERSE MAGNETIC FIELD. A.S.Gupta.
ngew. Math. Phys., Vol. 11, No. 1, 43-50 (Jan. 25, 1960).

538.3

9899 THE FLOW OF A CONDUCTING, VISCOUS LIQUID BETWEEN TWO POROUS PLATES.
Dzhorbenadze and D.V.Sharikadze.
.. Akad. Nauk SSSR, Vol. 133, No. 2, 299-302 (July 11, 1960).
ussian.

It is assumed that the liquid is moving in a constant and uniform netic field perpendicular to the two plates. An appropriate solu- of the equations of magnetohydrodynamics is obtained. Account is n of the flow through the porous material, but not of the inertia he compressibility of the liquid. As a result, the distribution of city and magnetic field strength in the liquid are obtained in ytic form. R.Eisenschitz

538.3

19900 FLUID MOTIONS IN A SPHERE. IV. THERMAL INSTABILITY OF A ROTATING FLUID SPHERE ATED WITHIN UNDER A UNIFORM MAGNETIC FIELD (2).
Namikawa.
Geomagn. Geoelect., Vol. 11, No. 4, 111-24 (1960).

For Pt III, see Abstr. 3660 of 1959. The conditions for which a id sphere heated within and subject to the simultaneous action of niform magnetic field and rotation can become unstable via a rginal state of purely oscillatory motion are studied. The sults are different from those of the author's earlier work (Abstr. 59 of 1959) and over-stability occurs both under astrophysical terrestrial conditions.

538.3

19901 NOTES ON MAGNETOHYDRODYNAMIC EQUILIBRIUM. S.Hamada.
ogr. theor. Phys., Vol. 22, No. 1, 145-6 (July, 1959).

A preliminary statement of various results obtained by taking vilinear coordinates (in each surface of constant pressure) rallel to the magnetic field and current flow.

H.N.V.Temperley

538.3

19902 THE EFFECT OF VISCOSITY ON THE STABILITY OF INCOMPRESSIBLE MAGNETOHYDRODYNAMIC STEMS. A.Hare.
il. Mag. (Eighth Ser.), Vol. 4, 1305-10 (Dec., 1959).

A variational principle is derived, which may be used to scuss the stability of incompressible magnetohydrodynamic stems in the absence of viscosity, and its application is briefly scribed. The effect of viscosity is then discussed and compari- n with the non-viscous case shows that conditions for stability rived in its absence are still valid.

538.3

19903 ON THE MAGNETOHYDRODYNAMIC INSTABILITY OF A GASEOUS CYLINDER. T.Ôki.
l. Rep. Tohoku Univ. First Ser., Vol. 43, No. 2, 113-20 (Aug., 1959).

The magnetohydrodnamic instability of an infinite gaseous linder with a prevalent longitudinal magnetic field and an electric rrent is investigated by using a perturbation method. The solutions r uniform current density and incompressible fluid are obtained der the assumptions of infinite electric conductivity and negligible avitational force. An application of the results to the formation star chains is briefly discussed.

538.3

19904 ANALOGIES AND DIFFERENCES BETWEEN VORTICITY AND THE MAGNETIC FIELD. J.Carstoiu.
.R. Acad. Sci. (Paris), Vol. 251, No. 4, 509-11 (July 25, 1960).
French.

An analogue in magnetohydrodynamics of the equation for vor- city is written as $D(\vec{H}/\rho)/Dt = \vec{\omega} \times \vec{H}/\rho + (1/2\rho)\partial G/\partial\vec{H}$, where $\vec{\omega}$ is e angular velocity of a fluid element and G a quadratic form in the mponents of $\vec{H}$ whose coefficients are given by the velocities of uid deformation. It is deduced that, in the case of the rigid-body otion of a uniform liquid, the intensity $\vec{H}$ and the current density $\vec{J}$ e of constant magnitude and the angle between these two vectors mains constant throughout the motion. R.A.Newing

538.3

19905 AN EXAMPLE OF ONE-DIMENSIONAL OSCILLATORY MOTION IN MAGNETOHYDRODYNAMICS.
N.Mugibayashi.
Progr. theor. Phys., Vol. 20, No. 2, 241-3 (Aug., 1958).

A class of exact oscillatory solutions of the one-dimensional magnetohydrodynamic equations for a perfect conductor is exhibited. The space is separated into two parts, in one of which the fluid is at rest while in the other it expands and contracts uniformly. The initial conditions include one arbitrary function. The motion is not a simple wave although it adjoins a stationary region. O.Penrose

538.3

19906 EFFECT OF A TRANSVERSE MAGNETIC FIELD ON THE "ESCAPE SPEED" OF A CONDUCTING FLUID.
C.Greifinger.
Phys. of Fluids, Vol. 3, No. 4, 662-4 (July-Aug., 1960).

Deals with the one-dimensional expansion of a gas initially at rest in a uniform transverse magnetic field into a vacuum permeated by a parallel but different valued magnetic field. Values of escape speed and shock Mach number are plotted as a function of the ratio of the magnetic pressure in vacuum to total gas pressure at rest for a monatomic gas. C.G.Morgan

538.3

19907 HYDROMAGNETIC OSCILLATIONS OF AN INCOMPRESSIBLE CYLINDER. R.Simon.
Ann. Astrophys., Vol. 22, No. 6, 712-26 (1959). In French.

This paper is concerned with the small oscillations of a self-gravitating homogeneous and incompressible cylinder of infinite length, in the presence of a magnetic field. In the interior of the cylinder, this field is assumed to be a uniform z-field, while in the surrounding vacuum, it results from the superposition of a uniform z-field and of a θ-field which varies like $1/r$. The electrical conductivity of the material is supposed to be infinite and the displacement currents are explicitly taken into account. Finally, an expression is derived which gives the proper frequencies of the normal modes of oscillation, which enables a discussion of the stability of the cylinder with respect to those modes.

538.3

19908 TOROIDAL OSCILLATIONS OF A SPHERICAL MASS OF VISCOUS CONDUCTING FLUID IN A UNIFORM MAGNETIC FIELD. K.Stewartson.
Z. angew. Math. Phys., Vol. 8, No. 4, 290-7 (July 7, 1957).

538.3

19909 CONTRIBUTION TO THE THEORY OF SIMPLE MAGNETOHYDRODYNAMIC WAVES. R.V.Polovin.
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 463-70 (Aug., 1960). In Russian.

The Riemann invariants are computed. The change of velocity in fast and slow magnetoacoustic waves is determined for the case when the magnetic pressure in front of the wave is much smaller than the hydrostatic pressure.

538.3 : 537.56

19910 BUILD-UP OF MAGNETOHYDRODYNAMIC WAVES IN A PLASMA MOVING THROUGH AN IONIZED GAS.
V.P.Dokuchaev.
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 413-15 (Aug., 1960). In Russian.

A dispersion equation is derived which describes the propagation of electromagnetic waves in a plasma moving through an ionized gas. The case of low frequencies (below the gyrofrequency of the ions), when the waves degenerate into magnetodynamic waves, is considered in detail. It is shown that if the velocity of the flow exceeds the Alfven wave velocity in the flowing and stationary plasma system, the latter becomes unstable. In this case, one of the normal waves begins to build up.

538.3

19911 ON THE INTERACTION OF STRONG SHOCK WAVES WITH AN ELECTROMAGNETIC FIELD.
V.P.Korobeinikov, and V.P.Karlikov.
Dokl. Akad. Nauk SSSR, Vol. 133, No. 4, 764-7 (Aug. 1, 1960). In Russian.

Two problems are considered: (1) a strong spherical shock wave, in a conducting gas with a weak magnetic field (magnetic field components after the wave passage are calculated; the resultant current is proportional to sin Θ, where Θ = angle measured from the direction of the initial magnetic field); (2) interaction of plane shock waves, sufficiently strong to ionize the gas, with a weak electromagnetic field; it is shown that the parameters of gaseous-dynamic waves can be determined once the parameters of the associated electromagnetic wave are known.

J.K.Skwirzynski

538.3

19912 MOTION OF A PISTON IN A CONDUCTING MEDIUM. R.V.Polovin.
Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1544-55 (1960). In Russian.

Considers magnetohydrodynamic waves produced when a piston moves in a perfectly conducting medium in the presence of a magnetic field. If the transverse velocity component of the piston exceeds the velocity of sound in the unperturbed medium a magnetic field is generated, and the magnetic pressure becomes comparable with the hydrostatic pressure. At supersonic velocities a vacuum is formed between the piston and medium (cavitation). Compared with ordinary hydrodynamics, additional cases of cavitation appear when the piston moves with supersonic velocity in the direction perpendicular to the normal to its surface and also when the angle between the piston velocity vector and the normal exceeds 70°(for an ideal gas with $\gamma = \frac{5}{3}$). Increase of the piston velocity component perpendicular to the normal decreases the drag. When cavitation occurs the drag is four times smaller than in the case of motion of the piston along the normal to its surface.

538.3

19913 SOME PROPERTIES OF STATIONARY FLOWS IN MAGNETOGASDYNAMICS. K.B.Pavlov.
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 304-7 (Aug., 1960). In Russian.

Stationary quasi-one-dimensional and one-dimensional flows are considered. It is shown that in the case of finite conducting media, the formation of a shock wave is possible under certain conditions.

538.3 : 523.87

19914 THE ADIABATIC MAGNETODYNAMIC EQUILIBRIUM OF A FLUID GASEOUS GRAVITATING MASS IN NON-UNIFORM ROTATION. C.Agostinelli.
R.C. Accad. Naz. Lincei, Vol. 28, No. 3, 278-83 (March, 1960). In Italian.

An axially symmetric isentropic perfectly conducting perfect gas in steady non-uniform rotation is considered. Some well-known first integrals of the governing equations are used to simplify these equations and to obtain some classes of particular solutions thereof.

O.Penrose

ELECTROMAGNETIC WAVES AND OSCILLATIONS

538.56 : 535.32

A SIMPLE DERIVATION OF THE KRAMERS—KRONIG RELATIONSHIPS. See Abstr. 19377

538.56 : 621.375.9

19915 CONSERVATION LAWS OF UNIFORM LINEAR HOMOGENEOUS SYSTEMS. M.C.Pease.
J. appl. Phys., Vol. 31, No. 11, 1988-96 (Nov., 1960).

A generalized linear homogeneous system is analysed for the quadratic forms that are invariant under it. Such forms lead to conservation laws that are properties of the system. If the system has n degrees of freedom, it will have at least n such conservation laws which together determine the "type" of the system. The analysis may be viewed as the determination of the metrics under which the operator becomes rotational. In such a metric, the square of the length of a vector is invariant. A conservation law is expressible as its appropriate metric. The Manley—Rowe relations for parametric devices, and Chu's kinetic power theorem for electron—beam devices are examples. The analysis is related both to the system operator and to a possible system matrix differential equation. In the latter case, this allows a direct connection between the conservation laws and the physical construction of the system. The converse problem in which two metrics are specified is also considered. The range of possible matrix diffe ential equations of a given type, and of system operators, is dete mined. Application is made to a uniform parametric line with "ideal forward coupling". Such a device will be stable in the se that it avoids internal feedback. If it is matched either on the in or output side, it will not oscillate regardless of its gain or elec al length. The necessary and sufficient conditions for this ideal behaviour are obtained by considering the invariant forms — the conservation laws — that it should obey.

53

19916 WAVES IN ELECTRON CLOUDS. J.R.Pierce and L.R.Walker.
Phil Mag. (Eighth Ser.), Vol. 4, 783 (June, 1959).

Reply to comment by Piddington on an earlier paper by the authors. (See abstr. 1248 of 1957 and 7111 of 1958).

19917 GENERATION OF MILLIMETER WAVES BY THE ELECTRON BEAM OF A MICROTRON.
E.Brannen, H.Froelich and T.W.W.Stewart.
J. appl. Phys., Vol. 31, No. 10, 1829 (Oct., 1960).

Reports the generation of power (0.5 mW) in the 8 mm regio using a conventional microtron with a homogeneous field generat power at 10 cm. The third orbit was extracted and focussed by magnetic quadrupoles into a cavity tuned for 8 mm. An improve form of microtron is under development.

A.E.I. Research Laborat

538

19918 MICROWAVE EMISSION FROM AN OPTICALLY PUMPED ATOMIC SYSTEM.
V.E.Derr, J.J.Gallagher, R.E.Johnson and A.P.Sheppard.
Phys. Rev. Letters, Vol. 5, No. 7, 316-18 (Oct. 1, 1960).

Microwave emission at about 9192 Mc/s, with power of 3×10^{-16} watt, was directly detected from an optically pumped ce containing Cs atoms at 10^{-6} mm and about 3 mm pressure of arg The experimental arrangement is outlined. The precautions take to establish that emission by the Cs atoms was being observed ar described. Tests with magnetic fields indicate that the transition $F = 4$, $m_F = 0 \rightarrow F = 3$, $m_F = 0$ appears to be the principal one involved. The linewidth of the emitted radiation is estimated as not more than 0.9 c/s, and much smaller widths are thought to be attainable. Emission is observed independently of polarization o filtration of the pumping light, and a magnetic field is not requi The exact pumping process is not clear, and discussion is given. The emitted radiation is regarded as the most stable monochrom source yet available, and it is predicted that a clock based on it would have a stability about one order of magnitude better than th of an ammonia beam maser.

J.Sher

538.56 : 621.3

19919 MOLECULAR AND ALLIED DEVICES FOR GENERATION AND AMPLIFICATION OF MICROWA
S.Deb and A.N.Daw.
J.sci. industr. Res., Vol. 18A, No. 11, 510-19 (Nov., 1959).

Recent developments are briefly reviewed. Simple expositio of the principle of operation and representative experimental arrangements of maser and mavar devices are given. The possi lities of developing devices using plasma interaction and Cheren radiation are also briefly outlined. The relative advantages and disadvantages of various classes of device and their present stat of development are critically discussed.

538

19920 SUBMILLIMETRE WAVES BY HARMONIC GENERATION FROM COLD CATHODE ARCS. K.D.Froom
Nature (London), Vol. 188, 43-4 (Oct. 1, 1960).

Continuation of previous work (Abstr. 3845, 15137 of 1960) using solid instead of Hg pool cathodes. Wandering of the cathod spot causes a large drop in harmonic output. The most successf cathode tried was calcium; this gave an output of about 10^{-8} watt at a frequency of 315 Gc/s for an input of a few watts at 35 Gc/s, a system in which the arc was not matched to the output waveguid

J.Du

538.56

921 ATOMIC HYDROGEN MASER.

H.M.Goldenberg, D.Kleppner and N.F.Ramsey.
Rev. Letters, Vol. 5, No. 8, 361-2 (Oct. 15, 1960).

'his is the first successful attempt to produce maser oscilla- with gaseous atoms. Atomic hydrogen from a Wood's dis- e source was state-separated in a six-pole magnet and the , m = 0 and F = 1, m = 1 states focused into a paraffin-wax- quartz bulb in the r.f. cavity. The cavity was tuned to the , m = 0 → F = 0, m = 0 transition (1420.405 Mc/s). The atoms ted whilst in the bulb and due to the small interaction with the fin walls were not seriously perturbed in 10^4 collisions. An action time of 0.3 sec was observed. Since the linewidth was 1 c/s a considerable improvement over existing time ards is possible. Both maser oscillation and stimulated sion were observed. D.Walsh

538.56

9922 FUSED SILICA CAVITY FOR A MASER OSCILLATOR.

F.O.Vonbun.
. sci. Instrum., Vol. 31, No. 8, 900-2 (Aug., 1960).

The method of fabrication of an ultra-stable resonant cavity g Quarzglas (fused silica), for an ammonia-beam maser is cribed. Good frequency stability has been obtained; the standard ation of a measured normalized beat frequency between two ers employing cavities of this kind is $\sigma_1 = 6.5 \times 10^{-10}$ over a od of 100 min. S.A.Ahern

538.56

9923 ADVANTAGE OF A CASCADED-CAVITY NH_3 MASER OVER THE SINGLE CAVITY MASER.

.Reder and C.J.Bickart.
. sci. Instrum., Vol. 31, No. 10, 1164-5 (Oct , 1960).

538.56

19924 LIMIT OF SPATIAL RESOLUTION OF REFRACTOMETER CAVITIES. V.J.Hartman.

Res. Nat. Bur. Stand., Vol. 64D, No. 1, 65-72 (Jan.-Feb., 1960).

Filter factors that determine an upper limit for the wave nbers for which refractometer measurements can be used to calcu- e the spectrum of refractivity are derived, based on the assumption t refractometers measure a weighted average of the refractive ex in a volume of air surrounding the centre of the refractometer ity. Two models are used assuming the weighting function has erical symmetry around the centre and one model is used assu- ng the function has cylindrical symmetry. All models result in a nple mathematical form which should be easy to use in further oretical developments.

538.56 : 534.1

BEATING OF WEAKLY-COUPLED NONLINEAR SYSTEMS.

Abstr. 19242

538.56 : 537.533

19925 IN WHAT SENSE DO SLOW WAVES CARRY NEGATIVE ENERGY? P.A.Sturrock.

appl. Phys., Vol. 31, No. 11, 2052-6 (Nov., 1960).

It has been found in the theory of electron tubes that, according the "small-amplitude power theorem", the fast and slow space- arge waves carry positive and negative energy, respectively. nilar analysis of different systems leads to similar results, ding one to conjecture that there is some sense in which one might sert that, for a wide class of dynamical systems, slow waves rry negative energy. In a one-dimensional model, "slow" and ist" waves in a moving propagating medium refer to waves of ich the phase velocity does or does not change sign, respectively, transforming from the moving frame to the stationary frame. all-amplitude disturbances of any dynamical system may be scribed by a quadratic Lagrangian function, from which one may m the canonical stress-tensor, elements of which are quadratic ctions of the variables which appear in the linearized equations motion. For any pure wave in this system, the energy density E d the momentum density P, as they appear in the canonical stress sor, are related to the frequency ω and wave number k by $= J\omega$, $P = Jk$, where $2\pi J$ is the action density. The rules for lilean transformation now show that the energy densities, as asured in the stationary frame, of fast and slow waves have itive and negative sign, respectively, if (as is usually the case) energy densities of both waves are positive in the moving frame. Similar arguments explain the signs of the energy density of the two "synchronous" waves which arise in the analysis of transverse disturbances of an electron beam in a magnetic field.

538.56 : 621.372.8

19926 NON-PERIODIC SLOW-WAVE AND BACKWARD-WAVE STRUCTURES.

P.J.B.Clarricoats and R.A.Waldron.
J. Electronics and Control, Vol. 8, No. 6, 455-8 (June, 1960).

The behaviour of the phase constant as a function of frequency is examined in the neighbourhood of cut-off for a waveguide of circular cross-section containing a concentric rod of dielectric or ferrite material. It is predicted from this behaviour that with suitable choices of geometry and properties of the rod, slow waves or backward waves will propagate.

538.56

19927 THE PROPAGATION OF A CONTINUOUS ELECTROMAGNETIC WAVE IN A LAMINARLY ANISOTROPIC MEDIUM. A.N.Tikhonov.

Dokl. Akad. Nauk SSSR, Vol. 126, No. 5, 967-70 (1959). In Russian. English translation in: Doklady (New York), Vol. 4, No. 3, 566-70 (Dec., 1959).

The object is to calculate the electromagnetic field on the surface of a laminar conducting medium when the field is produced by a given current distribution at the surface. For simplicity it is assumed that the circuit is, in fact an elementary dipole placed at a height h above the surface and the solution is then taken to the limit to which it tends as h tends to zero. V.G.Welsby

538.56

19928 VERTEX EXCITED SURFACE WAVES ON ONE FACE OF A RIGHT ANGLED WEDGE.

S.N.Karp and F.C.Karal, Jr.
Quart. appl. Math., Vol. 18, No. 3, 235-43 (Oct., 1960).

The problem of the propagation of electromagnetic waves by a magnetic line dipole source located at the corner of a right angled wedge is considered. It is assumed that an impedance or mixed boundary condition is prescribed on one of the wedge surfaces and that a homogeneous boundary condition is prescribed on the other. The impedance boundary condition is such that surface waves are generated. The amplitude of the surface wave generated is determined. A comparison is made between the magnitude of the surface wave for this problem and that of a magnetic-line dipole source located at the corner of a right angled wedge with the same impedance boundary condition prescribed on both surfaces. The far field amplitude of the radiated electromagnetic field is also given as an elementary function of the angle of observation.

538.56

19929 DIFFRACTION OF AN ELECTROMAGNETIC PLANE WAVE BY A METALLIC SHEET. W.E.Williams.

Proc. Roy. Soc. A, Vol. 257, 413-19 (Sept. 20, 1960).

A new generalized technique is developed for the solution of the problem of the diffraction of a plane wave incident at an oblique angle on an imperfectly conducting half-plane. It is shown that the solution may be deduced directly from the known scalar solutions for the half-plane. The case when the incident wave is E-polarized is considered in detail. The method of solution is applicable to the case of an H-polarized wave and also to the case when the diffracting structure consists of a finite number of parallel sheets of conducting material. The solution for an arbitrary incident wave may be obtained by superposition of the plane-wave solutions.

538.56

19930 SOLUTION OF A DIFFRACTION PROBLEM. I. THE WIDE DOUBLE WEDGE. II. THE NARROW DOUBLE WEDGE. H.M.Nussenzveig.

Phil. Trans A, Vol. 252, 1-30, 31-51 (Oct. 15, 1960).

The problem of radiation from a semi-infinite parallel-plate waveguide, terminated by an infinite plane flange ("double wedge") is investigated in the k-representation. The problem is reduced to an infinite system (S) of linear equations. Part I deals with the case of a "wide double wedge" (the width of the waveguide much greater than the wavelength). This may be considered as a perturbation of the problem of diffraction by a single rectangular wedge, the rigorous solution of which is known (Reiche 1912). In the k-representation, this solution satisfies an integral equation, which is a limiting form of system (S). This leads to an approximate solution of the wide double-wedge problem, which appears to be a very good approximation, except in the neighbourhood of critical frequencies of the waveguide. The diffraction patterns and the reflection coefficient are evaluated in this approximation. The accuracy and limits of applicability of classical diffraction theory are discussed. In the neighbourhood of critical frequencies, strong reflection appears. This is a new limiting case of the problem, which is connected with the theory of quasi-stationary currents. Neumann's iteration method is applied to system (S), in order to investigate the possibility that Kirchhoff's approximation is the first step of an accurate solution by successive approximations. The convergence of Neumann's series is discussed. In Pt II, the problem of diffraction by a "narrow double wedge" (width much smaller than wavelength) is investigated. Strong reflection and quasi-static effects are the main features of this problem. The asymptotic behaviour of the solution is determined by the edge singularities. This leads to an approximate solution, which seems to be very accurate. This solution is found to be in good agreement with approximate solutions derived by different methods. The reflection coefficient and the "end correction" are evaluated. The results are compared with those obtained by other authors. It is shown that they contain a new effect, the "evanescent mode correction", which is very small in this region. Resonance effects in channels of finite length are analysed.

538.56 : 534.26

DIFFRACTION OF A SCALAR WAVE BY A SLIT AND BY A CIRCULAR APERTURE IN A SCREEN OF ARBITRARY THICKNESS. See Abstr. 19296

538.56 : 534.26

DIFFRACTION OF A PULSE BY A RESISTIVE HALF-PLANE. See Abstr. 19301-2

538.56 : 537.56 : 621.391.812.624

19931 A THEORY OF INCOHERENT SCATTERING OF RADIO WAVES BY A PLASMA.

J.P.Dougherty and D.T.Farley.

Proc. Roy. Soc. A, Vol. 259, 79-99 (Nov. 22, 1960).

A theory is developed which describes the scattering of radio waves by the random thermal fluctuations of electron density in a collision-free plasma. The frequency spectrum, as well as the amplitude, of the scattered radiation is calculated. Particular attention is paid to the part of the spectrum which corresponds to small Doppler shifts, this being the region of greatest significance in connection with the phenomenon of incoherent scattering from the ionosphere. The calculations are based on a generalized version of Nyquist's noise theorem, and they lead to the following conclusions: (1) the mean scattering cross-section for the ionosphere is equal to that which would exist if each of the electrons scattered independently with a cross-section of one-half the classical Thomson cross-section: (2) the mean Doppler broadening of the scattered signal corresponds roughly to the speed of the ions rather than to that of the electrons: (3) the spectral shape of this signal is not Gaussian; there is a mild maximum in the spectrum away from the central frequency: (4) plasma resonance effects contribute only negligibly to the scattering for frequencies currently of interest.

538.56

19932 ESTIMATING THE ANGLE OF SCATTERING OF RADIO WAVES.

M.Lotova.

Astron. Zh., Vol. 36, No. 5, 907-9 (1959). In Russian. English translation in: Soviet Astron—AJ(New York), Vol. 3, No. 5, 881-3 (March-April, 1960).

An expression is derived for the dispersion of the angle of scattering of a plane electromagnetic wave in a statistically non-uniform medium. A discussion is given of the case where the dispersion of the refractive index is a slow function compared with the dimensions of the statistical irregularities.

538.56 : 621.371

19933 A DIPOLE ABSORBER FOR CENTIMETRE WAVES WITH REDUCED REFLECTION FOR OBLIQUE INCIDENCE.

G.Kurtze and E.G.Neumann.

Z. angew. Phys., Vol. 12, No. 9, 385-93 (Sept., 1960). In German.

Absorbers of this type are used, for example, for the screening of objects against detection by radar and for the construction of measuring chambers. The device consists of a series of small dipoles placed respectively perpendicular and parallel to a metal plate. V.G.Welsby

538.56 : 621.372

19934 ELECTROMAGNETIC WAVE PROPAGATION IN WAVEGUIDES CLOSE TO PERIODIC.

A.A.Sharshanov and K.N.Stepanov.

Zh. tekh. Fiz., Vol. 27, No. 7, 1474-81 (July, 1957). In Russian.

Calculates with the aid of Vladimirskii's equations [Zh. tekh. Fiz., Vol. 17, 1269 (1947)] the propagation of a wave of frequency ω in a chain of cavity resonators of radii b_n, length l_n, eigenfrequency ω_n, connected by apertures of radii a_n, where $a_n \ll b_n$, $a_n \ll l_n$, $a_n \ll c/\omega_n$ and $\omega \cong \omega_n$. The special case is discussed where the cavities and apertures (radius a_-) are the same for $n \leq 0$, and similarly for $n \geq N+1$ (aperture radius a_+), a travellin wave being found with slowly varying phase and amplitude. A special solution is found when the wave frequency ω is close to the edge of the pass-band. The case of a cylindrical waveguide loaded with dielectric disks is treated by generalizing the results of Fainberg and Khizhnyak [Zh: tekh. Fiz., Vol. 25, 711 (1955)], the disk arrangement being assumed in this case to deviate gradually from the periodic. Finally, the solution of difference equations wi slowly varying coefficients is discussed. D.E.Bro

538.56 : 621.372.8

19935 CALCULATION OF PROPAGATION CONSTANTS IN A H-MODE WAVEGUIDE WITH TRANSVERSELY MAGNETIZED FERRITE PLATE.

N.M.Kovtun and A.I.Tereshchenko.

Zh. tekh. Fiz., Vol. 30, No. 9, 1077-80 (Sept., 1960). In Russian.

The plate is placed next to the narrow wall of a guide which ha two ridges in the wide walls. The characteristic dispersion equati is quoted. The calculations were made for μ (diagonal component the permeability tensor of the ferrite) = 0.9; ϵ (dielectric constant of the ferrite) = 10; thickness of the ferrite plate = 3 mm; waveguid dimensions = 23 × 10 mm. The phase change coefficients are plotted as functions of the propagation constant and the distance between the ridges. J.K.Skwirzyns

538.56 : 621.372.8

19936 WAVEGUIDE WITH A "DUMB-BELL" SHAPED CROSS-SECTION.

A.I.Tereshchenko.

Zh. tekh. Fiz., Vol. 30, No. 9, 1074-6 (Sept., 1960). In Russian.

It is suggested that a waveguide with a "dumb-bell" shaped cross-section should incorporate the respective useful properties of circular cylindrical and of rectangular waveguides for H-mode transmission. J.K.Skwirzyn

538.56 : 621.386.

19937 DEVELOPMENT OF OPTIMUM BROADBAND OMNIDIRECTIONAL AERIALS.

H.G.Wahsweiler.

Z. angew. Phys., Vol. 12, No. 10, 450-61 (Oct., 1960). In German.

Perturbation method is used in the analysis of the boundary value problem of rotationally-symmetrical aerials. A simple expr sion is obtained for the change in reflection coefficient at the input with change of other parameters of the aerial; it is thus possible t arrive at the optimum design of the transition feeding the omnidirectional aerial. The impedance variations of these aerials are compared with those of conical aerials having like aperature angle The radiation patterns of each of the aerials constructed are simil to those of conical aerials with somewhat smaller aperature angle Z.F.Voyn

538.56 : 534.

FIELD STRUCTURE IN CYLINDRICAL WAVEGUIDES WITH A COMPLEX CROSS-SECTION. See Abstr. 19271

538.56 : 621.396.6

19938 THE RECEIVED POWER PATTERNS DUE TO MICRO WAVE PARABOLOIDAL REFLECTOR.

K.K.Dey and A.P.Kulshreshtha.

J. sci. industr. Res., Vol. 19B, No. 9, 325-9 (Sept., 1960).

A detailed mathematical theory is developed for the calculati of power patterns in the Fresnel and quasi-Fraunhofer regions fo a microwave paraboloidal reflector with a dipole source at its foc Two different methods for evaluating the integral in the expressio for received power are described. The theory was experimentall verified for a simplified case of the power received along the axi of the paraboloid in the Fresnel and quasi-Fraunhofer regions.

538.56

9939 **ON THE SOLUTION OF THE INTEGRAL EQUATION FOR THE COASTAL REFRACTION OF ELECTROMAGNETIC /ES.** I.N.Minin.
l. Akad. Nauk SSSR, Vol. 133, No. 3, 558-60 (July 21, 1960).
ussian.

The method of Sobolev (Izvestiya Akademii Nauk Armen'skoi R, Vol. 11, No. 5, 1958; Astronomicheskii Zhurnal, Vol. 36, 4, 1959; Abstr. 1646, 6674 of 1958) is applied and shown to yield same result for the case treated by Fok (Matematicheski rnik, Vol. 14(56), No. 1-2, 1944). J.M.Hough

538.56 : 534.21

PROPAGATION OF ELECTROMAGNETIC WAVES IN A HALF- ACE. See Abstr. 19266

538.56 : 534.21

LIMITS OF APPLICABILITY OF THE METHOD OF "SMOOTH" RTURBATIONS IN THE PROBLEM OF RADIATION PROPA- TION THROUGH A MEDIUM CONTAINING INHOMOGENEITIES. Abstr. 19265

538.56 : 523.78

19940 **PROPAGATION MECHANISM OF HIGH FREQUENCY WAVES RELATED TO THE ANNULAR ECLIPSE OF TH APRIL, 1958.** S.Kanaya and K.Ueno.
p. Ionosphere Res. Japan, Vol. 12, No. 2, 188-95 (June, 1958).

Discusses the h.f. propagation mechanism on the solar-eclipse y and on other days, with reference to the results of measurements field intensity, angle of elvation and bearing. It is found that ospheric sounding at the path mid-point and the measurement of gle of elevation at the receiving point are particularly useful for dying the propagation mechanism of h.f. wave transmitted over stances < 3000 km. The enhancement of the field intensity at the aximum eclipse is quantitatively analysed, taking the propagation echanism determined into consideration and assuming recombin- ion as the principal process of the disappearance of free electrons the absorption layer.

538.56

19941 **MEASUREMENTS OF CHANGES IN THE PHASE PATH OF RADIO WAVES REFLECTED FROM THE IONO- HERE AT NORMAL INCIDENCE.** R.W.E.McNicol and J.A.Thomas.
stral. J. Phys., Vol. 13, No. 2, 120-31 (June, 1960).

Fixed-frequency measurements were made at Brisbane, using lse transmissions, of the changes in phase of radio waves received ter reflection at normal incidence from the various ionospheric yers. Because of the homodyne detector used, such phase-path cords have a very good signal-to-noise ratio. Also, due to the fference in behaviour of echoes of different polarization or from fferent ionospheric layers, the effective resolution is high. When e echoes had a well-defined phase, the rate of change of phase with me was measured; the slowest rates were for smooth night-time $_s$ layers, when values as low as 1 m sec^{-1} were sometimes found, hereas for the night-time F_2 region the rates were usually in the ange 10-40 m sec^{-1}. Records were also made of reflections from rifting E_s clouds, and of the effect of underlying E_s ionization on eflections from the F_2 region. See also following abstract.

538.56 : 551.5

19942 **EXPERIMENTAL RELATIONS BETWEEN IONO-SPHERIC TRUE HEIGHT, GROUP HEIGHT, AND PHASE EIGHT.** J.A.Thomas and R.W.E.McNicol.
ustral. J. Phys., Vol. 13, No. 2, 132-8 (June, 1960).

Computations of ionospheric phase height at a particular requency were made using true height analyses of h f curves. Tem- oral changes in these computed values agreed well with experi- entally measured changes of phase path both in the case of regular iurnal variations and during an eclipse. The true height analyses ere thus shown to be experimentally reliable, and at the same ime one could allot an "absolute" value to the normal phase-path ecords. See also preceding abstract.

538.56

19943 **REFLEXION LEVELS AND COUPLING REGIONS IN A HORIZONTALLY STRATIFIED IONOSPHERE.**
M.L.V.Pitteway.
Phil. Trans A, Vol. 252, 53-66 (Oct. 15, 1959).

The propagation of radiowaves through a horizontally stratified and slowly varying ionosphere is governed, in the case of oblique incidence, by a quartic equation (Booker 1938). Ray theory breaks down when two roots of this quartic are equal, for then coupling occurs between the characteristic waves, and full wave theory must be used. This paper is concerned with determining the conditions under which the two roots are equal; it is not concerned with the full wave theory. Values of the plasma frequency, and electron collision frequency, which lead to equal roots, are determined, and are exhibited in a set of curves. A full solution of the "Booker" quartic is also given for a case of special interest. It is pointed out that the electric wave-field is unlikely to become very large in a slowly varying ionosphere, so that, if the ionosphere were irregular, scattering cannot be unduly enhanced by a plasma resonance.

538.56 : 621.391.812.63

19944 **THE FADING OF LOW-FREQUENCY RADIO WAVES REFLECTED FROM THE IONOSPHERE.** W.A.Cilliers..
J. atmos. terrest. Phys., Vol. 19, No. 2, 102-14 (Oct., 1960).

A study has been made of the fading of radio waves of frequency 70-200 kc/s reflected at steep incidence from the ionosphere. It is shown that the amplitude fading on 113 kc/s is sufficiently consistent to be represented by an average correlogram. Some measurements of the complex amplitude are reported and the correlograms deduced from them are compared with those derived from measurements of real amplitude. On all frequencies there is a component of fading with a correlation time (to e^{-1}) of order 90 sec corresponding to a fading period of order 7.5 min and there is some evidence that this component of the fading is quasi-periodic. This quasi-periodic component is noticeable on a cross correlogram relating measurements made simultaneously on waves of quite different frequencies, from which it is deduced that it is caused by a quasi-sinusoidal irregularity in the ionosphere, which effects all the frequencies. Observations at three spaced receivers show that these irregularities have a spatial period of order 20 km and that they travel with speeds of about 35 m sec^{-1}. This drift of the irregularities is an important cause of the fading. On the higher frequencies there is clear evidence of a more rapid component of fading with a correlation time of the order 50 sec.

538.56

19945 **SECOND-ORDER FARADAY ROTATION FORMULAS.** K.C.Yeh.
J. geophys. Res., Vol. 65, No. 8, 2548-50 (Aug., 1960).

In current observations of 20- and 40- Mc/s satellite signals, the frequencies are not very much higher than the plasma frequency in the ionosphere, and the first-order theory may be in appreciable error, owing to effects of refraction. This note introduces a second-order theory in which the high-frequency approximation and the effect of refraction are taken into consideration. The correction from the first-order theory on 20 Mc/s is found to be of the order of 5% for close passages, but may be as large as 30%.
A.Boksenberg

538.56

19946 **A POSSIBILITY OF THE LONG DISTANCE H.F. PROPAGATION ALONG THE EXOSPHERIC FIELD-ALIGNED IONIZATIONS.** T.Obayashi.
Rep. Ionosphere Space Res. Japan, Vol. 13, No. 3, 177-86 (Sept., 1959).

Transequatorial very long range echoes of the order to 7000 km detected by the h.f. back-scatter sounder at Hiraiso are interpreted as the ground backscatter propagation launched on the path along the exospheric field aligned ionizations. Ray path calculation on this longitudinal mode of propagation between the geomagnetically conjugate points along its field line is made for various geomagnetic latitudes. The expected echo distance agrees well with that obtained by the experiments. It is also found that the average exospheric electron density deduced from the observed echo spreads is about $10^4 \sim 10^5$ electrons per cm^3. A possible use of this propagation mode of backscatter as a tool of exospheric sounding is suggested.

538.56

19947 **ANGLES OF ARRIVAL OF A V.H.F. SIGNAL IN IONOSPHERIC FORWARD PROPAGATION.**
K.Miya, T.Sasaki and M.Ishikawa.
Rep. Ionosphere Space Res. Japan, Vol. 13, No. 3, 187-200 (Sept., 1959).

Describes a newly developed voltage ratio meter which is capable of measuring the voltage ratio of two signals at low signal/noise ratio. Bearing and angle of elevation have been observed by using the equipment on 50 Mc/s in ionospheric forward propagation over a 1560 km path between Okinawa and Tokyo. The bearing deviates westward from the true bearing by 5 to 10 degrees on an average at night and southward by a few degrees early in the afternoon. The angle of elevation was between 3.4° and 3.7° and attains a minimum about noon. Standard deviations of these angles and of signal strength show remarkably small values early in the morning. Correlation with variation of angles and signal strength is also explained, exhibiting typical records of evening enhancements.

538.56 : 621.391.812.63

19948 THE PROPAGATION OF FADING WAVES.

R.P.Mercier.

Phil Mag. (Eighth Ser.), Vol. 4, 763-76 (June, 1959).

A scalar wave with random variations of amplitude and phase across the wave-front is assumed as a simple model of a radio wave after it has left the ionosphere. The second-order moments of the in-phase and quadrature components of the fluctuating part of the field are found using the Fresnel diffraction formula. It is assumed that these two components have a joint Gaussian distribution, and a parameter ρ_N, called the intrinsic correlation of the fading, is introduced; this serves as a measure of the eccentricity of the ellipse of constant probability. It is shown that ρ_N is the amplitude of the diffraction pattern produced by a distribution of intensity proportional to the spatial correlation function of the fluctuations over the wave-front. As the wave propagates the correlation tends to zero. It is shown that for a given irregularity size and wavelength, the irregularities may be supposed to be situated at any height, up to a certain maximum height, at which $\rho_N = 1$. An analysis of day time fading on 16 kc/s was made. It appears that the intrinsic correlation of the wave at the ionosphere is very near one, and that the ionosphere imposes phase modulation on the wave.

538.56 : 621.391.822.622

19949 THE "WAVEGUIDE MODE" THEORY OF RADIO WAVE PROPAGATION WHEN THE IONOSPHERE IS NOT SHARPLY BOUNDED.

D.W.Barron.

Phil. Mag. (Eighth Ser), Vol. 4, 1068-81 (Sept., 1959).

The propagation of radiowaves to great distances can be treated by considering the space between the earth and the ionosphere as a waveguide and discussing the properties of the various waveguide modes. Previous authors have generally assumed that the upper boundary of the waveguide is a sharply bounded ionosphere. A method of calculating the mode characteristics for any horizontally stratified ionosphere in which the electron density and collision frequency vary with height in some arbitrary prescribed manner is described. The theory is given in full for a flat, perfectly conducting earth with no magnetic field, and its extension is outlined in an appendix. Results of some calculations carried out on EDSAC 2 are given. The effect on the waveguide modes of changing from a sharp to a gradual boundary on an otherwise homogeneous ionosphere is investigated by considering a variation of electron density (N) with height (z) according to the law

$$N = N_0(1 + \tanh \beta(z-h))$$

using a range of values of β, and mode characteristics are also calculated for an ionosphere in which the electron density increases exponentially with increasing height. The effect on the waveguide modes of changes in the parameters of the expontial model, and the difference between the modes for vertical and horizontal polarization are described.

538.56 : 538

HIGH STABILITY PROTON RESONANCE MAGNETIC FIELD REGULATION WITH AN ELECTRONIC INTEGRATOR. See Abstr. 19871

538.56 : 529

MASER TIME AND FREQUENCY STANDARD. See Abstr. 18892

Radiofrequency Spectroscopy Techniques

538

19950 7-th AMPERE CONFERENCE — PARIS, 1958.

Arch. Sci. (Geneva), Vol. 11, Special No., 316 pp. (19

In English and French.

This conference, the 7th Colloque Ampere, dealt with the following topics: dielectrics; electron paramagnetic resonance; and nuclear paramagnetic resonance. Seventy two papers were presented.

538.

19951 A RECORDING MICROWAVE SPECTROMETER FOR THE STUDY OF GASES AT MEDIUM PRESSURES.

D.Ilias.

J. Phys. Radium. Vol. 20, No. 6, 653-5 (June, 1959). In French.

A spectrometer for recording the coefficients of absorption a refractive indices as a function of pressure at microwave frequen is described. This is basically similar to that described by Gozzini (Abstr. 3445, 3664, 4488 of 1954) and by Battaglia (Abstr. 960, 971 of 1958). The maximum sensitivity is an absorption of 0.5×10^{-3} neper/metre for full scale deflection of the recorder; variations of the order of 10^{-8} in the index of refraction are detectable. S.A.Ah

538.

19952 ANALYSIS OF A MAGNETIC RESONANCE SPECTROMETER.

J.P.Goldsborough and M.Mandel.

Rev. sci. Instrum., Vol. 31, No. 10, 1044-6 (Oct., 1960).

An electron paramagnetic resonance microwave bridge spectr meter is analysed, and expression are given for the relation betwe the signal and the imaginary part of the magnetic susceptibility. From these the conditions for maximum signal are obtained. The analysis is also applicable to many other types of magnetic resonance spectrometer.

538.5

19953 CALCULATION OF THE SIGNAL TO NOISE RATIO F CERTAIN EQUIPMENT USED FOR RECORDING NUCLEAR RESONANCE.

P.Drăghicescu.

Stud. Cercetari Fiz., Vol. 9, No. 3, 355-66 (1958). In Roumanian.

Tow block diagrams, used for recording nuclear resonance signals were compared from the point of view of signal to noise ratio. The diagram with single sweeping and direct recording wa compared to the diagram with double sweeping and differential recording. Under similar conditions the second system is shown to be advantageous.

538.56 : 621.314

19954 SENSITIVITY AND FIDELITY OF AUTODYNE OSCILLATORS IN RADIOFREQUENCY SPECTROSCO

M.Buyle-Bodin.

J. Phys. Radium, Vol. 20, Suppl. No. 12, 159A-166A (Dec., 1959). In French.

The computing of the level of oscillation for an h.f. oscillator, in which there is a modulated absorption of energy, shows that thi oscillator acts like a selective low-frequency circuit; damping in this circuit depends on the level of oscillation. It is found that an autodyne oscillator when used to display directly the resonance lines in microwave spectroscopy cannot have good fidelity when adjusted for maximum sensitivity. An oscillator is described and the patterns of the resonance lines obtained are discussed.

538.

19955 A METHOD OF MEASURING T_1 BY SPIN ECHOS.

A.Csaki and G.Béné.

C.R. Acad. Sci. (Paris), Vol. 251, No. 2, 228-9 (July 11, 1960). In French.

After reversal of the magnetization, return of the longitudinal component of the magnetization to its equilibrium value is measured by a series of pulses. A sequence of three pulses, (90°, 180° then 90°) is used to measure the longitudinal component and the sequence is repeated several times at intervals shorter than T_1 so that the recovery curve may be observed in one experiment. J.M.Bak

NUCLEAR AND ATOMIC PHYSICS

539

956 NUCLEAR PHYSICS. [Physique nucléaire].
M.Bayet.
Masson et Cie (1960) 404 pp. In French.

is book gives a treatment of low energy nuclear physics at l usually associated with the second year of a three year rsity Course. In Part I the relevant theoretical background en in a rather concentrated form. Quantum mechanics is ed but quantum concepts are introduced by simple wave nical considerations. This part includes quantum statistics, atics of two body collisions and the concept of cross-section, mb scattering, the main features of angular momenta and or atoms and nuclei, and the special theory of relativity ing the dynamics of the Lorentz transformation. Part II oted to the structure of the nucleus. The topics treated are properties including binding energy and electric and mag- moments, nuclear forces, nuclear models, radioactive trans- tions, and α, β and γ decay. Barrier penetration is treated decay and selection rules given for β and γ decay. The treat- of nuclear forces and models is inevitably rather brief. In II interactions with matter are discussed. Topics treated nge-energy relations for charged particles, bremsstrahlung, ton effect, pair-production, methods of detection. Then follows oter on neutrons, their interactions and methods of production etection. The last chapter is devoted to nuclear reactions ling fission and fusion. There is an appendix giving the wave nical derivation of scattering by a potential well. The book newhat sparsely provided with diagrams and tables, particu- in proportion to the amount of algebra. A list of general ences is provided and specific references are given in parti- cases which are considered important. A.Ashmore

539

957 ATOMIC AND NUCLEAR PHYSICS.
R.S.Shankland.
d. New York: Macmillan (1960) xvi + 665 pp.

ee Abstr. 2308 for review of 1st edition. The later half of the has been completely revised with the addition of considerable naterial. These include accounts of antiparticles, parity e in weak interactions including neutron decay, electron— on interactions, bubble chamber results etc. The chapter on ar Energy Sources has been largely rewritten. A 75 page dix of problems has been added.

539

958 PROGRESS IN NUCLEAR PHYSICS. Vol.6.
Edited by O.R.Frisch.
on: Pergamon Press (1957) 297 + vii pp.

This volume contains 9 review articles, a foreword and a name subject index. J.B.Birks

539

9959 HIGH-ENERGY NUCLEAR PHYSICS CONFERENCE.
J.C.Polkinghorne.
. Today, Vol. 12, No. 12, 36, 38, 40 (Dec., 1959).

Report of a conference held at Kiev, 15-25 July, 1959.

539

9960 I.V.KURCHATOV (1903-1960).
I.P.Alexandrov and I.K.Kikoin.
ear Phys., Vol. 17, No. 2, 177-80 (June (3), 1960).

Reviews Kurchatov's work on dielectrics and nuclear physics. ains a 13-item bibliography of Kurchatov's principal papers.

539

9961 DONALD J.HUGHES (1915-1960).
J.A.Harvey.
ear Phys., Vol. 20, No. 1, 1-9 (Oct. (2), 1960).

A fairly detailed survey of Hughes' work in nuclear physics a list (57 items) of his principal contributions.

APPARATUS . PARTICLE DETECTORS

539.1.07 : 537.54 : 621.384.612 : 621.317.7

19962 CERN MEETING ON NUCLEONIC INSTRUMENTATION FOR HIGH ENERGY PHYSICS. Edited by G.von Dardel.
Nuclear Instrum., Vol. 2, No. 2, 73-218 (Feb., 1958).

The conference was held from 30 Sept.-2 Oct., 1957 to discuss the instrumentation required for the high-energy accelerators coming into operation in various parts of Europe. There were six sessions dealing with the following topics: (1) nanosecond techniques, (2) counting and storage systems; (3) and (4) information handling systems and other problems of big experiments; (5) transistor circuits; (6) standardization of nuclear equipment. Abstracts of some of the papers will be found in this or succeeding issues of Science Abstracts.

539.1.07

19963 STUDY OF THE PHENOMENON OF DETERIORATION OF SELF-QUENCHING GEIGER—MÜLLER COUNTERS.
F.E.M.Lox and G.P.Van Der Kelen.
J. Phys. Radium, Vol. 20, Suppl. No. 12, 131A-138A (Dec., 1959).
In French.

As an unambigous criterion for determining the deterioration of a G.M. counter tube, the value $\Delta V_I/\Delta V_H$, the change in pulse-height as a function of the applied high-voltage is defined. A study was made of the relative importance of the three main constituents of a G.M. counter on its characteristics. A systematic study was made of the influence of anode, cathode and of the gas-phase composition. It is shown that the poor functioning of a much used counter can be ascribed to two different factors: changes of the gas phase, that influence mainly the plateau characteristics and changes on the anode surface that cause a gradual decrease of the value $\Delta V_I/\Delta V_H$. This is taken as evidence that the changes of the anode surface influence the multiplication process.

539.1.07

19964 LOW BACKGROUND END-WINDOW GEIGER-MÜLLER COUNTER. H.Kobayashi.
Sci. Pap. Inst. Phys. Chem. Res. (Tokyo), Vol. 54, 16-19 (March, 1960).

This counter is for the exact measurement of weak β-ray activities. The centre wire of the counter is provided with a mica disk guard as the β-ray absorber, dividing the counter into two separate compartments, each serving as an independent counter. With a mica end-window of 2 cm diameter and lead-block shielding 5 cm thick, the natural background count is reduced to 2 ~ 4 counts per min having the two component counters in anticoincidence.

539.1.07

19965 THE PROPORTIONAL COUNTER AS A CHARGED PARTICLE SPECTROMETER.
S.A.Husain and A.A.Jaffe.
Nuclear Instrum. and Methods, Vol. 6, No. 1, 50-6 (Dec., 1959).

A proportional counter is described which is suitable as broad range charged particle spectrometer for the investigation of nuclear reaction products. Its performance was investigated experimentally and an energy resolution of 1.6% was obtained with protons of 8 MeV.

539.1.07

19966 A NEW METHOD FOR TRACK ANGLE MEASUREMENT IN A GRIDDED IONIZATION CHAMBER.
U.Facchini, E.Gatti and F.Pellegrini.
Nuclear Instrum. and Methods, Vol. 4, No. 4, 221-7 (May, 1959).

A simple method of handling the information at the collector of a conventional gridded ionization chamber is described. This method, based on the evaluation of the maximum of the current at the collector, allows direct information to be obtained on the angle formed by the tracks of the particles with the electric field. This maximum value is independent from the position of the track within the sensitive volume and from the energy of particles of identical mass. Other uses are range-energy study, the development of neutron spectrometers based on the energy of gas recoil, and (n,p) and (n,α) studies in which the angular distribution of the emitted particles is involved.

539.1.07

19967 CONSTRUCTION OF A STABLE GASEOUS SCINTILLATOR USING ARGON, WITHOUT A WAVELENGTH SHIFTER. A.Perrin and R.Chery.
J. Phys. Radium, Vol. 20, Suppl. No. 7, 92A-94A (July, 1959).
In French.

The performance of a gaseous scintillation counter using argon, and no wavelength shifter, is discussed. The average number of photoelectrons obtained per scintillation was 225 for 5.3 MeV α-particles which, with a photomultiplier gain of 7×10^6, gave a pulse height resolution of 21.5%. It is pointed out that a resolution of about 8% is theoretically possible using xenon and α-particles of 5.3 MeV. The cost of recovering and purifying the xenon would, however, be high. C.F.Barnaby

539.1.07 : 535.37 : 532.7

SCINTILLATION IN NOBLE GASES AND THEIR MIXTURES. See Abstr. 19160

539.1.07

19968 CONICAL PLASTIC SCINTILLATORS SHOW TOTAL GAMMA ABSORPTION. G.J.Hine and J.A.Cardarelli.
Nucleonics, Vol. 18, No. 9, 92, 94, 96, 98, 100 (Sept., 1960).

Light collection from 2 in. high plastic cylinders in greatly improved by forming the sides into a 10° cone. The resolution obtained with 600 keV electrons is improved from 24% to $19\frac{1}{2}\%$ and the pulse height increased by 60%. R.D.Smith

539.1.07 : 539.2 : 535.37 : 621.387.464

THE PROCESSES INVOLVED IN THE IMPROVEMENT OF PLASTIC SCINTILLATORS. See Abstr. 18146

539.1.07

19969 DIMETHYL STYRENE YIELDS MORE EFFICIENT SCINTILLATORS.
S.R.Sandler, S.Loshack, E.Broderick and P.Bernstein.
Nucleonics, Vol. 18, No. 9, 102-3 (Sept., 1960).

The pulse heights from various dimethyl ring substituted plastics were compared with anthracene. 2,4-dimethyl styrene gives a pulse height 60% higher than polystyrene. Preparation of the scintillator from the monomer is described. R.D.Smith

539.1.07

19970 DESIGN CALCULATIONS FOR NaI SYSTEMS.
W.F.Miller and W.J.Snow.
Rev. sci. Instrum., Vol. 31, No. 8, 905-7 (Aug., 1960).

The results are given of a set of calculations employing the computer programme described by the authors (Abstr. 2511 of 1960). The effect of increasing the crystal diameter while holding the beam collimation and crystal height constant is shown. For narrowly collimated beams there appears to be little gain in resolution in increasing the diameter to a value greatly exceeding the height.
C.F.Barnaby

539.1.07

19971 THE COLLECTION OF LIGHT FROM SCINTILLATION COUNTERS. R.L.Garwin.
Rev. sci. Instrum., Vol. 31, No. 9, 1010-11 (Sept., 1960).

A system is described which allows the light from a light-guide or scintillating vat to be concentrated onto a small phototube. The system involves the use of two converters in which the light produces fluorescence of slightly lower photon energy. Using the optical arrangement suggested a sacrifice of a factor of about 4 in total light energy is involved at each conversion but one might be able to achieve a factor of about 100 in light intensity.
C.F.Barnaby

539.1.07 : 539.2 : 535.37

SOME CONSIDERATIONS ON LUMINESCENT FIBER CHAMBERS AND INTENSIFIER SCREENS. See Abstr. 18150

539.1.07 : 539.12

19972 TWO USES OF PROBABILITY PAPER IN SCINTILLATION GAMMA-RAY SPECTROSCOPY. I.F.Boekelheide.
Rev. sci. Instrum., Vol. 31, No. 9, 1001-2 (Sept., 1960).

Plotting the photo peak of a scintillation spectrum on probability paper has been found useful for checking the internal consistency of electronic apparatus, and for determining the half-width in a more objective manner than on a linear plot. D.W.L.Sprung

539

19973 EFFICIENCY AND COLLECTION TIME DISPERSIO OF THE LIGHT FROM A CHERENKOV DETECTOR WITH REFLECTING WALLS.
J.Séguinot, M.Scherer and J.Teiger.
Nuclear Instrum. and Methods, Vol. 5, No. 3, 170-6 (Sept., 1959
In French.

The distribution of rise time of Cherenkov pulses has been measured for a Cherenkov detector of $23 \times 10 \times 10$ cm^3 with re flecting outer surfaces, and constant output level. A method of study of linings is proposed. A detection efficiency of nearly 10 was measured. The detector is associated with cloud chambers for scattering measurements of μ mesons.

539.1

19974 ON THE PHENOMENA OF POLARIZATION IN CdS CRYSTAL COUNTERS. M.Marinov.
C.R. Acad. Bulg. Sci., Vol. 11, No. 6, 445-8 (Nov.-Dec., 1958).
In French.

The conditions under which CdS crystal counters can be operated under d.c. conditions without taking particular precaut to eliminate space-charge effects are evaluated in a general theoretical analysis, and have been investigated experimentally.
C.H.B.

539

19975 DETECTION OF MINIMUM IONISING PARTICLES SILICON P—N JUNCTIONS. H.W.Mann and W.W.Ma
Rev. sci. Instrum., Vol. 31, No. 8, 908-9 (Aug., 1960).

Internal conversion electrons of energies between 62 and 1046 keV were detected by means of Si junction diodes at approp ate reverse bias voltages. It is considered feasible to use such diodes as detectors of minimum ionizing particles. K.W.Ples

539.

19976 AMBIENT RADIATION MONITOR.
A.R.Jones.
Nucleonics, Vol. 18, No. 8, 80-2 (Aug., 1960).

A transistorized circuit with a halogen filled detector in a specially shielded probe. The output is logarithmic from 10 μr to 10 mr/hr and the monitor does not block at levels up to 200
R.D.S

539

19977 X-RAY SPECTROMETRY EXTENDS FILM-BADGE DOSIMETRY. W.V.Baumgartner.
Nucleonics, Vol. 18, No. 8, 76, 78-9 (Aug., 1960).

The concentration of silver atoms in a developed film is measured by exciting characteristic Ag X-rays. The upper lim 40 r possible by optical measurement can be extended to 2000 r this method. R.D.S

539.1.07 : 5

19978 A WAVELENGTH-INDEPENDENT RECORDING DOSIMETER FILM. K.Becker, E.Klein and E.Zeit
Naturwissenschaften, Vol. 47, No. 9, 199-200 (1960). In Germa

The dependence of the response of silver halide films on t wavelength of the primary radiation, can be compensated by sui admixtures of organic fluorescent materials, through the opposi directed dependence of the blackening on the fluorescent light wavelength. It was found that the sensitivity of AgBr/p-terphen emulsions with a 1 : 5 weight ratio is constant over a wide regi radiation energy, from 200 keV to above 1 MeV.
I.C.Demetsopo

539.1.07 :

19979 EXAMINATION OF FISSION FRAGMENT TRACKS WITH AN ELECTRON MICROSCOPE.
E.C.H.Silk and R.S.Barnes.
Phil. Mag. (Eighth Ser.), Vol. 4, 970-2 (Aug., 1959).

Thin sheets, removed by cleavage from the surface layers mica exposed to fission fragments from uranium, were examin in transmission in the electron microscope. Fission fragment tracks which are less than 300 A in diameter and greater than in length were seen, superimposed upon a general background troduced by associated neutron bombardment. The nature of th tracks is discussed. The technique can be used to study radiat induced atomic displacements, and the nature and behaviour of particles themselves, with higher resolution than has previous been possible.

539.1.07

0

EXPERIMENTAL DYNAMICS OF BUBBLE CHAMBER WINDOW FAILURES.

iero, I.Pless, L.Hyman and D.Cronin.
. Instrum., Vol. 31, No. 8, 910-11 (Aug., 1960).

investigation of the rate of rise of pressure in a safety box
viewing window in a methyl iodide bubble-chamber fails;
ie velocity and spatial distribution of the glass fragments
g from explosions due to this has been made using a small
r in order to determine safe dimensions for a 15 in. chamber
onstruction. The experimental arrangement is described
results discussed. S.A.Ahern

539.1.07 : 539.12

USE OF BUBBLE CHAMBERS FOR EXPERIMENTS WITH HIGH ENERGY GAMMA-RAY BEAMS.

riero, H.Mark, I.A.Pless, L.Rosenson, Y.Shapira, A.Tuchman
.Yamamoto.
i. Instrum., Vol. 31, No. 10, 1040-3 (Oct., 1960).

sual particle detection methods have been used with high
bremsstrahlung beams of low intensity. A method for
ng a substantial increase in the gamma-ray beam intensity
an be passed through a 9 in. propane bubble chamber is
ed. The beam is collimated and then led through a hollow
ssing through the middle of the bubble chamber. It was found
e of a "beam tube" increases the number of events observed
ture by a factor between five and ten over the number found
beam tube. The 300 MeV bremsstrahlung beam of the M.I.T.
otron beam was used for these experiments. Advantages and
ions of the beam tube method are discussed.

539.1.07 : 536.48

QUID HYDROGEN BUBBLE CHAMBERS: DEVICE FOR
IAL CONTROL. See Abstr. 19570

539.1.07 : 539.12

ETERMINATION OF THE MASSES AND MOMENTA OF
IGED PARTICLES FROM MULTIPLE SCATTERING
SUREMENTS IN A PROPANE BUBBLE CHAMBER. See
. 2[illegible]

539.1.07 : 539.12

ETECTION OF X-RAY IMAGES WITH BUBBLE CHAMBERS.
ostr. 20104

539.1.07

982

THE EFFECT OF PROCESSING CONDITIONS ON SPURIOUS SCATTERING IN NUCLEAR EMULSIONS.

mond, C.Patou and M.Scherer.
Acad. Sci.(Paris), Vol. 251, No. 5, 700-2 (Aug. 1, 1960). In
ch.

Scattering measurements were made on tracks of 1.5 BeV/c
esons in 400μ N.I.K.F.I. type R and Ilford G5 emulsions sub-
d to glycerine concentrations of 2 and 6%, fast and slow drying,
ot and cold development. E.J.Burge

539.1.07

983

ON THE FIXING OF THICK NUCLEAR EMULSIONS.

I.J.Van Heerden and J.G.McEwen.
o Cimento, Vol. 17, No. 5, 671-7 (Sept. 1, 1960).

Rate of fixing, clearing time, swelling and corrosion of
G-5 and K-5 emulsions were studied for different fixing
ions under rigidly controlled conditions. Curves are given
may be used to predict when it is advisable to change some of
xers.

539.1.07

984

HYPERSENSITIZATION OF ILFORD NUCLEAR EMULSIONS BY TRIETHANOLAMINE.

raggi and A.Garin.
o Cimento, Vol. 17, No. 6, 830-6 (Sept. 16, 1960). In French.

It is possible to improve by a factor of the order of 1.7 the
itivity of K-5 emulsions using appropriate treatment based on
9.5 solution of triethanolamine and citric acid.

539.1.07

19985

COMPARISON OF THE MEAN GAP LENGTH IN ILFORD G-5 EMULSION WITH THEORY.

D.J.Holthuizen.
Nuovo Cimento, Vol. 17, No. 6, 928-37 (Sept. 16, 1960).

Describes ionization measurements on the tracks of particles with velocities corresponding to β between 0.25 and 0.8. The results were obtained by the determination of the mean gap length. A theoretical curve is calculated with the help of the well-known relation between the relative grain density and the velocity as checked by Jongejans and the relation between the mean gap length and the grain density as given by Barkas. The results are in agreement with this theory.

539.1.07

19986

APPARATUS FOR THE DEVELOPMENT OF NUCLEAR EMULSION PLATES. W.Lohmann.

Nuclear Instrum. and Methods, Vol. 5, No. 3, 194-5 (Sept., 1959).

539.1.07

19987

PERFORMANCE OF A NUCLEAR EMULSION SCANNER. P.V.C.Hough.

Nuclear Instrum. and Methods, Vol. 6, No. 1, 33-44 (Dec., 1959).

A machine was constructed which meets many of the needs for scanning of nuclear emulsions used in charged particle nuclear spectroscopy. Methods developed for track detection are reviewed briefly. In more detail an account is given of the performance of the machine in scanning plates exposed at the Michigan 42 in. cyclotron over a seven months period. Finally, some special techniques which may have other applications are described.

539.1.07

19988

PHOTOGRAPHIC TRACKING OF ELEMENTARY PARTICLES. C.F.Powell.

Science, Vol. 132, 1134-6 (Oct. 21, 1960).

Review article.

539.1.07

19989

ON A POSSIBILITY OF DETERMINING Z BY MEANS OF δ RAYS. C.Beşliu and M.G.Petraşcu.

Stud. Cerçetari Fiz., Vol. 10, No. 1, 37-45 (1959). In Roumanian.

Describes a new method of determining the Z number of light nuclei, by means of the density g of δ rays and the number which stop. From the relation

$$N/N_0 = (Z/Z_0)^{(n+4)/n} \text{ (where } n = 2 \text{ or } 1.5)$$

one can determine the charge Z, by knowing, between the same densities g and g_1 $(g \neq g_1)$, the numbers N and N_0 of δ rays belonging to the track of unknown Z and the comparison track of Z_0. The method can also be applied to tracks which do not stop in the emulsion. The method has been verified for 6 protons and 5 α-particles; it has a precision between 4 and 17%. A.Ashmore

539.1.07

19990

METHOD OF DISCRIMINATION OF NEUTRONS AND OF γ-RAYS.

G.Ambrosino, F.Cambou and J.P.Crettez.
C.R. Acad. Sci. (Paris), Vol. 251, No. 5, 703-5 (Aug. 1, 1960). In French.

A description of the application of pulse shape discrimination to a recoil proton spectrometer using an anthracene scintillator. The response of the system to 2.7 MeV neutrons and to γ-radiation from a composite source is shown. J.E.Gore

539.1.07

19991

CONTRIBUTION TO THE MEASUREMENT OF THE INTERVAL OF TIME OF BETWEEN 10^{-9} AND 10^{-7} SECONDS: ON A DIFFERENTIAL COINCIDENCE SELECTOR BY TIME—AMPLITUDE CONVERSION ADAPTED TO SLOW SCINTILLATORS. R.Chery.

C.R. Acad. Sci. (Paris), Vol. 251, No. 5, 694-6 (Aug. 1, 1960). In French.

539.1.07

19992 A COINCIDENCE CIRCUIT USING A TIME–PULSE HEIGHT CONVERTOR.

S.Gorodetzky, T.Muller, M.Port, G.Bergdolt and J.Graff.
J. Phys. Radium, Vol. 20, Suppl. No. 7, 49A-54A (July, 1959). In French.

With the clipping lines used, the convertor has a linear region of 0.5 × 10^{-8} sec, and a variation in delay of 2.5 × 10^{-11} sec corresponds to a variation in amplitude of 1%.

539.1.07 : 621.374.32

19993 FAST TRANSISTORIZED TIME-TO-PULSE-HEIGHT CONVERTER.

G.Culligan and N.H.Lipman.
Rev. sci. Instrum., Vol. 31, No. 11, 1209-14 (Nov., 1960).

A transistorized time-to-pulse-height convertor is described which has a timebase range of 0 to 15 nsec, and a stability of 10^{-10} sec. The circuit has been used for the mass analysis of particle beams by time-of-flight. Time resolutions of 10^{-9} sec were obtained using conventional scintillation counters. The circuit has a short dead time (3 × 10^{-7} sec), contains a gating facility, but is of simple design. It has been in use at C.E.R.N. for the previous six months, and functions satisfactorily under experimental conditions.

539.1.07 : 621.374.32

19994 A THREE-DIODE FAST COINCIDENCE CIRCUIT.

R.Meunier and J.Teiger.
Nuclear Instrum. and Methods, Vol. 5, No. 3, 148-51 (Sept., 1959). In French.

A differential coincidence circuit is described which has an effective resolving time < 1 mμs. The principle consists of having two pulses travelling in opposite directions through the same coaxial cable, and they meet at a given point. The circuit is very simple. It has been built for use in experiments with high energy accelerators.

539.1.07

19995 SINGLE-CHANNEL TIME-INTERVAL ANALYSER FOR THE SPECTROMETRY OF FAST PARTICLES WITH AN APPLICATION TO THE METHOD OF TIME-OF-FLIGHT IN THE REGION OF NANOSECONDS.

N.Martalogu, F.Tsinte, R.Dumitresku, I.Korgueva and M.Molya.
Rev. de Physique (Bucarest), Vol. 4, No. 4, 457-74 (1959). In Russian.

Time-of-flight velocity measurements using impulses from scintillation counters are invalidated by the pulse length when flight times fall to nanoseconds (10^{-9} sec). By employing a pair of coincidence counters and subjecting these to phase discrimination, much shorter pulses may be obtained. The authors' apparatus, working on this principle, is fully described and experimental checks are recorded. For equal pulses, a time resolution of 2.5 × 10^{-11} sec at 100% efficiency is obtained. Satisfactory results at lower efficiency are obtained for the coincidences of unequal pulses. A.E.I. Research Laboratory

539.1.07

19996 A 1000 CHANNEL TIME-OF-FLIGHT ANALYSER.

J.Apter, J.Roussel, J.M.Tissier and R.Wahl.
Nuclear Instrum. and Methods, Vol. 5, No. 5, 300-11 (Nov., 1959). In French.

An Argonne type analyser is described with magnetic core memory used for data storage. It is used as a time analyser for spectrum measurements of neutrons by time-of-flight analysis. The apparatus is able to count statistically the number of neutrons corresponding to a determined energy and to store the data in a memory. The spectrum can be seen on a cathode ray tube and then traduced channel by channel, printed or recorded. There are three inputs each corresponding to one particular group of channels, permitting its use simultaneously with three detectors. A simple commutation allows: (1) changing of the region of interest, setting the group of 1000 channels on a scale of 10 000 T (T being the channel width) by steps of 100 T; (2) obtaining an address correction, directly correcting the number of channels lost during the time of memory cycle; (3) choice of channel width.

539.1.07 : 621.374.32

19997 TRANSISTORIZED COINCIDENCE CIRCUIT FOR π-e EXPERIMENT.

R.H.Miller.
Rev. sci. Instrum., Vol. 31, No. 10, 1047-51 (Oct., 1960).

A special purpose coincidence circuit with millimicroseco resolution time is described which illustrates the simplicity th can be achieved with transistorized circuits. The circuit perfo all the logical operations of three simultaneous experiments to measure the branching ratio to the electronic mode of pion dec Performance data under operating conditions on the cyclotron a given.

539.

19998 TRANSISTOR AMPLIFIER FOR FAST PROPORTIO COUNTING.

J.B.S.Waugh and R.W.Nicholson.
Nucleonics, Vol. 18, No. 7, 70, 72-74 (July, 1960).

An amplifier designed for operation at repetition rates up 50 kc/s. A current pulse input circuit with diode limiters gives effective overload protection. R.D.

539.1.07 : 621.37

19999 FAST SCALING CIRCUITS.

G.W.Hutchinson, W.H.Wells and D.H.White.
Nuclear Instrum. and Methods, Vol. 4, No. 4, 228-33 (May, 195

A scaler of 11 mμsec dead time has been designed and bui for use at the Birmingham proton synchrotron. This unit is des cribed, and the circuit elements that are used to define the dea time of scalers are discussed.

539.

20000 SIMPLE CORE SCALING CIRCUITS.

J.C.Barton.
Nuclear Instrum. and Methods, Vol. 5, No. 5, 332-4 (Nov., 1959)

A new type of core scaler is described which requires only transistor per stage. Details are given of a scale of ten which ates from a 6 V supply, consumes 1.5 mW at 1000 counts per se and has a resolving time of 5 μsec. It is possible to obtain a re ing time of 1 μsec with a scale of two. These circuits are not c ally dependent on component values.

539.

20001 REGULARIZING ACTION OF SCALERS.

J.Sandstad.
Nuclear Instrum. and Methods, Vol. 4, No. 4, 243 (May, 1959).

A note on the fraction of input pulses lost to dead time in a scaler preceded by a fast one.

539.1.07 : 621.3

20002 A LOGARITHMIC, CONSTANT PERCENT ERROR, PULSE HEIGHT ANALYZER.

A.Alberigi-Quaranta, C.Bernardini, C.Infante and I.F.Quercia.
Nuclear Instrum. and Methods, Vol. 5, No. 2, 120-3 (Aug. 1959).

A single channel pulse-height analyser with a dead time of about 0.15 μsec is described. The channel width is determined the passive characteristics of a delay line and is a constant per age of the discriminator setting. An important feature of the device is a paralysis circuit. Circuit diagrams and calibration curves are given.

539.1.07 : 68

20003 PUNCHED TAPE READOUT FOR A MULTICHANNE PULSE-HEIGHT ANALYZER.

J.Brotzman.
Rev. sci. Instrum., Vol. 31, No. 10, 1073-6 (Oct., 1960).

An instrument for transfering information from a magnetic core memory to punched tape is described. When used with a 100 channel pulse-height analyser with a capacity of 10^5 counts p channel, total readout time for all 100 channels is less than 17

539.1.07 : 681.142 : 621.3

20004 PROPOSAL FOR AN ANALOG-TO-DIGITAL ELECTRONIC CONVERTER SUITED FOR NUCLEA PULSE HEIGHT ANALYSIS.

A.Alberigi, C.Bernardini and I.F.Quercia.
Nuclear Instrum., Vol. 3, No. 4, 201-3 (Oct., 1958).

An analog-to-digital converter is proposed based on the use delay lines as codifying elements. Application of the converter pulse height analysers, with one or more channels, is discusse Preliminary experimental work is briefly reported.

539.1.07

05 A PULSE TO DIRECT CURRENT VOLTAGE COMPARATOR. C.H.Vincent and W.G.King.
ar Instrum. and Methods, Vol. 6, No. 1, 57-65 (Dec., 1959).

simple instrument is described which enables pulse voltages measured very accurately by comparing them with direct it voltages. The pulses may be of the order of 1 μsec to ec in duration and up to 60 V or so in amplitude, of either The error in the measurement is of the order of a few parts , at most, for the larger voltages.

539.1.07 : 621.374.32

006 STRETCHER FOR SHORT COUNTER PULSES. W.F.Cummins and D.R.Branum.
sci. Instrum., Vol. 31, No. 11, 1247-8 (Nov., 1960).

539.1.07 : 621.374.5

07 MULTIRANGE DELAY LINE FOR APPLICATION IN BETA-GAMMA COINCIDENCE STUDIES.
u Plessis, P.W. De Lange and W.Weidemann.
ar Instrum. and Methods, Vol. 5, No. 2, 127-8 (Aug., 1959).

he circuit of a counting signal delay unit with a range of 1.4 μsec of steps in 0.1 μsec is described. A continuously table delay line (0.05 μsec per cm) covers a range of 1.5 μsec. onstruction and design formulae of the latter delay line are .

539.1.07 : 621.382.3 : 621.374.32

008 ON THE USE OF 2N504 TRANSISTORS IN THE AVALANCHE MODE FOR NUCLEAR INSTRUMENTATION.
llwood.
sci. Instrum., Vol. 31, No. 11, 1186-9 (Nov., 1960).

Philco 2N501, 2N502, and 2N504 transistors were operated essfully in the avalanche mode as fast discriminators on photoplier tubes and as the pulse generating element in pulse geners. They exhibit the property of a fast rise time (<~ 1 nsec) and p discriminating characteristics but have the disadvantage of a recovery time (~ 80 nsec).

NUCLEAR FIELD THEORY

539.11

0009 ON THE QUANTUM CONDITIONS IN FIELD THEORY. IV. R.S.Liotta.
vo Cimento, Vol. 17, No. 5, 703-25 (Sept. 1, 1960).

For previous parts, see Abstr. 2480 of 1960. The covariant tional formalism is applied to the Feynman—Gell-Mann spinorial ation. The first order approximation of the W.K.B. method is nded to field theory, giving the corresponding quantum conons. Applying these results to free fields, a relationship is found ween various quantum numbers in field theory.

539.11

0010 THE UNIVERSAL CONSTANT LIMITING THE VALIDITY OF THE QUANTIZED FIELD THEORIES. W.Heitler.
vo Cimento Suppl., Vol. 6, No. 1, 340-3 (1957).

Arguments are given for the suggestion that there is a universal -off in quantum field theory. From the mass difference of the rged and neutral pions it appears that this cut-off is of the order he nucleon mass. Such a cut-off introduces no inconsistencies in ntum electrodynamics, and corresponds roughly to the minimum tance in which experimental derivations have been made.

E.J.Squires

539.11

20011 NON-LINEAR GENERALIZATIONS OF THE FIELD THEORY AND THE CONSTANT OF MINIMAL LENGTH.
vanenko.
ovo Cimento Suppl., Vol. 6, No. 1, 349-55 (1957).

It is shown how non-linear generalizations of the usual field ations can arise from the mutual transformation of particles. amples of gravitational, scalar meson and spinor fields are conered. The induced non-linearity is related to a universal minimal gth or momentum cut-off. Some support for the idea of a universal -off is presented.

E.J.Squires

539.11

20012 CAUSALITY IN A NON-LOCAL FIELD THEORY AND A COVARIANT FORMULATION OF INTERACTION BETWEEN FIELDS BASED ON THE INTRODUCTION OF A UNIVERSAL LENGTH. G.Wataghin.
Nuovo Cimento Suppl., Vol. 6, No. 1, 399-400 (1957).

A formulation is given of a nonlocal field theory which satisfies macroscopic causality (for full account, see Abstr. 7576 of 1957).

E.J.Squires

539.11

20013 REMARKS ON THE CANONICAL ENERGY-PSEUDOTENSORS OF GENERAL COVARIANT WAVEFIELD THEORY. G.Knapecz.
Z. Naturforsch., Vol. 15a, No. 5-6, 467-70 (May-June, 1960).
In German.

The two pseudotensors θ_i^k and Θ_i^k are shown to provide weak and strong conservation laws, even for an unclosed system. It is also shown that when the Lagrange function is the sum of N scalars the strong conservation identity degenerates into N distinct parts. It is concluded that the two pseudotensors are unsuitable representations of energy.

R.A.Newing

539.11

20014 ON THE INTEGRAL REPRESENTATION OF THE DOUBLE COMMUTATOR. C.Eftimiu and S.Klarsfeld.
Nuovo Cimento, Vol. 17, No. 6, 902-7 (Sept. 16, 1960).

A new derivation of the Dyson integral representation for the double commutator is given. It is shown that the Jacobi identity might be incorporated into this integral representation by imposing further restrictions on the weight function.

539.11

20015 A METHOD FOR SOLVING FIELD THEORY PROBLEMS INVOLVING A STATIONARY NUCLEON.
B.M.Barbashov and G.V.Efimov.
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 450-60 (Aug., 1960).
In Russian.

The formalism is not connected with the magnitude of the coupling constant and is based on the matrix methods for solution of linear differential equations developed by Lappo-Danilevskii. The solution is obtained in the form of a series for which the concrete form of the n-th term is known. The S-matrix is derived for the scalar charge theory with a stationary source. The renormalization constants are calculated. In this model logarithmic singularities do not appear in the renormalized charge g_r upon the transition to point interaction.

539.11

20016 SPECIAL METHODS OF ANALYTIC COMPLETION IN FIELD THEORY. R.F.Streater.
Proc. Roy. Soc. A, Vol. 256, 39-52 (May 31, 1960).

By combining known theorems in the theory of functions of many complex variables and distribution theory a technique of analytic completion is developed; this provides a simple proof of the "edge of the wedge" theorem. An integral representation for the double commutator is derived, and it is used to simplify some of the work involved in computing the envelope of holomorphy for the vertex function. The Jacobi identities have not been incorporated, with the consequence that the threefold case cannot be completely solved by this method. The technique is applied to the fourfold (scattering) function, again without the Jacobi identities being included. By this technique analytic completion can be performed for some but not all the domains encountered in the fourfold problem.

539.11

20017 ON THE GAUGE PROPERTIES OF GREEN'S FUNCTIONS. I.Bialynicki-Birula.
Nuovo Cimento, Vol. 17, No. 6, 951-5 (Sept. 16, 1960).

The transformation properties of Green's functions in quantum electrodynamics are derived by functional analysis. Also, the generalized Ward identities and branching equations are obtained from differential equations for the generating functional.

539.11

20018 RENORMALIZATION OF THE EQUATION OF THE TWO-ELECTRON GREEN'S FUNCTION. M.Kraev.

C.R. Acad. Bulg. Sci., Vol. 13, No. 3, 265-7 (May-June, 1960). In Russian.

Renormalized quantities are substituted into the equations for the two-electron Green's function. D.J.Thouless

539.11

20019 INTERMEDIATE SYSTEMS IN QUANTUM ELECTRODYNAMICS. M.S.Livshits.

Dokl. Akad. Nauk SSSR, Vol. 126, No. 3, 550-3 (May 21, 1959). In Russian. English translation in: Soviet Physics—Doklady (New York), Vol. 4, No. 3, 609-13 (Dec., 1959).

Some results are derived that are in disagreement both with experiment and with the results of renormalization theory.
D.J.Thouless

539.11

20020 ON THE ASYMPTOTIC AND CAUSALITY CONDITIONS IN QUANTUM FIELD THEORY. II. F.Kaschluhn.

Nuovo Cimento, Vol. 17, No. 4, 609-(Aug. 16, 1960).

Summarizes conclusions of a forthcoming paper extending previous work by the author (Pt I, cf. Abstr. 9238 of 1959) on the connection between the interaction representation and the functional-derivative representation. The latter, it is claimed, will be shown to eliminate the redundant asymptotic condition in the derivation of S-matrix elements, thereby permitting an investigation of a possible non-causal structure of quantum field theory, which would have been precluded on the interaction representation. J.W.Gardner

539.11

20021 A SIMPLIFIED METHOD OF CALCULATION FOR RELATIVISTIC PROCESSES IN QUANTUM ELECTRODYNAMICS. P.Kessler.

Nuovo Cimento, Vol. 17, No. 6, 809-29 (Sept. 16, 1960). In French.

The starting point is a quantum field theoretical generalization of the semi-classical Williams—Weizsäcker method, which defines an equivalent photon spectrum for a relativistic charged particle. It is then shown that a formula of the Williams-Weizsäcker type can be set up to express the probability associated with any elementary diagram containing two fermion lines and one photon line, provided that both fermion states are relativistic. The elementary virtual processes represented by these diagrams may thus be considered as "quasi real processes". Several examples are given, in which this concept is applied to calculate higher order processes by relating them directly to simpler effects. The cases treated are:
(1) bremsstrahlung of a relativistic particle at a given angle;
(2) nuclear recoil from pair creation by high-energy photons;
(3) inner bremsstrahlung in the disintegration of the μ-meson;
(4) radiative corrections in the compared β-ray spectra of B^{12} and N^{12}. In conclusion, further possibilities to extend the method (especially to π-meson theory) are briefly discussed.

539.11 : 530.12

INTERPRETATION OF ELECTRODYNAMICS WITHIN A SIX-DIMENSIONAL MANIFOLD. See Abstr. 18937

539.11

20022 GRAPHICAL ANALYSIS OF INFRARED DIVERGENCES. S.Okubo.

Nuovo Cimento, Vol. 18, No. 1, 70-6 (Oct. 1, 1960).

By the graphical method, it is proved that all infrared divergences in quantum electrodynamics can be summed up into a simple form, and the result is a generalization of the classical Bloch—Nordsieck formula.

539.11

20023 THE INFRARED CATASTROPHE IN SCALAR QUANTUM ELECTRODYNAMICS. V.A.Shakhbayan.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 484-90 (Aug., 1960). In Russian.

The asymptotic behaviour of the four-vertex function in the infrared region is investigated in quantum electrodynamics of spin-zero particles. A procedure is discussed for removing the infrared divergences and summation of the probabilities for charged meson—meson scattering involving the emission of an arbitrary number of soft quanta.

539.11

20024 THE VACUUM IN QUANTUM ELECTRODYNAMICS. P.A.M.Dirac.

Nuovo Cimento Suppl., Vol. 6, No. 1, 322-39 (1957).

An approximate expression is obtained for the true vacuum quantum electrodynamics. The error is due to the simultaneous production of at least two electron—positron pairs, and is there proportional to $(e^2/\hbar c)^2$ multiplied by a divergent integral. It do not follow from the derivation that this approximate state corre ponds to the minimum eigenvalue of the Hamiltonian. E.J.Squ

539.11 : 53

20025 COULOMB GAUGE IN NON-RELATIVISTIC QUANTU ELECTRO-DYNAMICS AND THE SHAPE OF SPECT LINES. E.A.Power and S.Zienau.

Phil. Trans A, Vol. 251, 427-64 (Sept. 15, 1959).

An examination is made of the Green dyadic for the propagation functions of non-relativistic quantum electrodynamics in Coulomb gauge div A = 0. The existence of false precursors is shown to be associated with singularities at the origin in certain momentum space representations of the propagators and this all a prescription to be given to eliminate such precursors. This p scription is proved equivalent to an exact consideration of the ne fields associated with quantum transitions. The analogous treat for the state vectors in decaying systems is carried through and applied in detail to the problems of the shape of natural spectral and the transition rate for stimulated emission. It is shown that expected line shape for the Lamb 1057 Mc/s line in hydrogen is Lorentzian within the context of Lamb's experiments — intensit against Zeeman splitting energy. This is in contradiction to the dictions of Arnous and Heitler (Abstr. 1025 of 1954). The distribution in k (circular frequency) for a natural line, on the other h has a factor k^3 times the resonant denominator. The definitive position between the conflicting transition rates in the literature given. The relationship of the calculations to a gauge-independe Hamiltonian, considered in the paper, is investigated in detail. Hamiltonian, transformed canonically from the conventional one, is shown to be valid for internal, dynamical, quantized electromagnetic fields; its analogue in the case of external applied field being well known. It is demonstrated that the transformation eliminates many of the difficulties associated with the false near fields and that it also allows certain radiative effects, where the atom acts as a whole, to be computed in a straight-forward mann

539.

20026 DISCRETE SYMMETRIES AND CHIRALITY INVARIANCE IN QUANTUM FIELD DYNAMICS.

E.G.C.Sudarshan.

Proc. Indian Acad. Sci. A, Vol. 49, No. 2, 66-85 (Feb., 1959).

Discusses the discrete symmetry operations on a quantized field in interaction, and the introduction of the new quantum num "chirality" for spinor field based on these symmetry properties. Several general results on the group of symmetry operations ar proved and a relation is established between certain sets of discrete symmetry operations and the spinor representation of the rotation group in 3 and 4 dimensions. An attempt is made to pre sent the connection between additive and multiplicative quantum numbers, gauge transformations, unitary transformations and invariance laws. The chirality invariance of spinor fields in int action is discussed. The emphasis throughout is on the systema development rather than on details of application.

53

20027 INCONSISTENCY AMONG THE PROPERTIES OF RENORMALIZABILITY, ANALYTICITY, AND REGULARITY AT ZERO CHARGE. S.C.Frautschi.

Prog. theor. Phys., Vol. 22, No. 6, 882-8 (Dec., 1959).

The photon propagator is analysed by means of general properties of the present theory of electrons and photons. It ca be shown, by consideration of the charge renormalization group, that the photon propagator is independent of physical charge in t high energy limit. If, in addition to renormalizability, regularit at vanishing physical charge is assumed, then it follows that the bare charge vanishes. On the other hand, the commonly assume analyticity properties require that bare charge exceeds physical charge. Thus at least one of the general properties assumed is inadmissible. This relationship of expressions satisfying the ch renormalization group equations to analyticity properties and definite sets of Feynman diagrams (which correspond to an expansion about zero charge) is illustrated by a simple example

539.11

28 **ON THE ONE-BODY PROPAGATOR.** K.Watanabe.

theor. Phys., Vol. 22, No. 6, 895-7 (Dec., 1959).
example is discussed where there is no Hamiltonian and
Lehmann's density function has "abnormal" properties.
ggested that such a situation may be required in order to
ertain divergence difficulties. J.E.Paton

539.11

029 **ON A POSSIBLE SMALL PAULI TERM IN QUANTUM ELECTRODYNAMICS.** K.Aizu and T.Honda.

. theor. Phys., Vol. 22, No. 6, 897-9 (Dec., 1959).
vidence for or against such a term, arrived at from the differ-
etween experimental Lamb shifts and those predicted by quan-
ectrodynamics, is inconclusive. J.E.Paton

539.11

30 **BOUND STATES IN QUANTUM ELECTRODYNAMICS.** T.C.Roy.

d Culture, Vol. 25, No. 9, 536 (March, 1960).
method is given which "seems to handle bound states along
similar to the free ones". P.K.Kabir

539.11

031 **ON THE RENORMALIZATION OF BETA COUPLING.** K.Baumann and A.Höld.

phys. Austriaca, Vol. 13, No. 4, 473-5 (1960).
he renormalization of the vector and axial vector current is
lated for a single Dirac field which is coupled to itself. A
cal Fermi-type interaction is introduced which has been
ed by Abrikosov et al.(Abstr. 6628 of 1958). In the limit of
nonlocality the renormalization can be performed nonpertur-
nally. Vector nonrenormalization and an axial vector renorma-
on factor greater than one are found for the following types of
interaction: (a) tensor coupling, (b) axial vector coupling,
ive coupling constant, (c) scalar and pseudoscalar coupling,
ive coupling constant.

539.11

032 **PARITY NONCONSERVATION IN WEAK INTERACTIONS. I.** O.R.Frisch.

ress in nuclear physics, Vol. 6 (London: Pergamon Press,
) p.267-73.
A review of the experimental evidence for parity nonconserv-
. The experiments discussed include β-decay from oriented
ei, π—μ—e decay, the magnetic moment of the muon, muonium
depolarization of muons, the polarization of the nucleus after
cay, the polarization of β-particles, and the screw neutrino.
J.B.Birks

539.11

0033 **PARITY NONCONSERVATION IN WEAK INTERACTIONS. II.** T.H.R.Skyrme.

ress in nuclear physics, Vol. 6 (London: Pergamon Press,
) p. 274-85.
A review of the theoretical basis of parity nonconservation in
interactions. The possibilities introduced by relaxing the
ction symmetry requirements of space (parity), time (time
rsal) and charge (charge conjugation) are considered. Topics
ussed include the scattering matrix, Lorentz invariance, beta
y, the two-component theory of the neutrino, and the mu meson.
J.B.Birks

539.11

0034 **MAXIMAL WEAK INTERACTIONS.** K.Aizu.

r. theor. Phys., Vol. 22, No. 2, 192-206 (Aug., 1959).
All possible weak processes are systematically enumerated,
the hypothesis of a maximal set of interactions, that there is
ys a weak interaction among any combination of all kinds of
icles, is investigated. It is found that this maximal interaction
el is equivalent to the minimal interaction model in the sense
the experimental facts are described equally well by these two
els, provided that a selection rule which forbids at least the
earance of μ—e pair is added to the former model.

539.11 : 53

20035 **POSSIBILITY OF SUPER-WEAK INTERACTIONS AND THE STABILITY OF MATTER.** Y.Yamaguchi.

Progr. theor. Phys., Vol. 22, No. 3, 373-80 (Sept., 1959).

There may exist some extremely weak interactions called here "super"-weak interactions, which are much weaker than usual weak interactions. As a possible example of such interactions the "metastability" of matter is discussed.

539.11

20036 **ON RADIATIVE CORRECTIONS TO WEAK INTERACTION PROCESSES.**

Ya.A.Smorodinskii and Khe Tszo-Syu [Ho Tso-Hsiu].

Zh. eksper. teor. Fiz., Vol. 38, No. 3, 1007-8 (March, 1960). In Russian.

The essential difference is pointed out between processes such as μ-decay on the one hand and β-decay on the other so that renormalized radiative corrections can be calculated for the former but not the latter. This results in ambiguities in the definition of the coupling constant. R.F.Peierls

539.11

20037 **LIMITS OF APPLICABILITY OF THE WEAK INTERACTION THEORY.** B.L.Ioffe.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1608-14 (1960). In Russian.

Weak interactions are assumed to conserve their form at high energies. Then, due to the weak-interaction radiative corrections, the equality between the vector interaction constants for β-decay and μ-decay should be violated and $\mu \to e + \gamma$ and $\mu \to 3e$ processes should appear. These radiative corrections are computed and by making a comparison with the experiments the upper limit is established for energies up to which the weak interaction theory is valid.

539.11

20038 **ON THE POSSIBILITY OF THE TWO-FERMION INTERACTION.** H.Obayashi.

Progr. theor. Phys., Vol. 22, No. 6, 835-42 (Dec., 1959).

As the general source for non-leptonic weak interactions, an elementary two-fermion (Λ—n) interaction is introduced and investigated. The calculated asymmetry factors and decay rates for Λ and Σ decays show that this interaction, with some corrections due to the strong pion—baryon interactions, does not seem sufficient to describe these decay processes. Hence we cannot ascribe the main features of weak interactions to the two-fermion interaction only.

539.11

20039 **GHOST STATES AND PAIR EFFECTS IN THE LEE MODEL.** L.M.Scarfone and W.A.McKinley.

Nuovo Cimento, Vol. 17, No. 5, 678-86 (Sept. 1, 1960).

Pauli and Källen's treatment (Abstr. 1052 of 1957) of the one particle V-states in the ordinary Lee model is applied to Goldstein's extension of the Lee model (Abstr. 7687 of 1958) which includes pair effects in the θ-particle. Contrary to an earlier conclusion, it is shown that there is simultaneously a ghost state in the V-spectrum with energy greater than the normal V energy as well as a ghost in the θ-spectrum for negative values of one of the renormalization constants.

539.11

20040 **LEE MODEL WITH SINGLE BOSON OSCILLATOR.** G.Barton.

Nuovo Cimento, Vol. 17, No. 6, 864-75 (Sept. 16, 1960).

The Heisenberg equations turn out to be linear, and the problem is soluble in all sectors. The spectrum is entirely and essentially discrete, and the physically interesting questions relate not to scattering but to straightforward energy measurements. In particular, all the consequences of introducing an indefinite metric can be traced out explicitly; it appears that no consistent physical interpretation can be given.

539.11

20041 **THRESHOLD EFFECTS IN HIGH ENERGY REACTIONS.** A.I.Baz.

Phil. Mag. (Eighth Ser.), Vol. 4, 1035-45 (Sept., 1959).

The resonances which occur in high energy phenomena are interpreted in terms of threshold states. Tentative conclusions are drawn regarding the parities of some of the elementary particles.

539.11

20042 REMARKS ON THE FINAL STATE INTERACTION IN FERMI'S THEORY OF MULTIPLE PARTICLE PRODUCTION. S.Ishida.
Progr. theor. Phys., Vol. 22, No. 2, 207-12 (Aug., 1959).

A method of modifying Fermi's statistical formula of multiple particle production (Abstr. 3336 of 1951) is presented. It consists of expressing the "matrix element" of Fermi's theory as an integration of plane waves in the effective interaction volume, and then replacing this free-state wave-function by that of interacting particles. Its application to the π—N system and deuteron production is given. Belenky's formalism on the same problem (Abstr. 5866 of 1957) is critically discussed.

539.11

20043 STRONG INTERACTIONS AND BARYON MASS LEVELS. B.Bransden and G.Moorhouse.
Progr. theor. Phys., Vol. 22, No. 3, 396-402 (Sept., 1959).

Using a cut-off version of the Hamiltonian of d'Espagnat and Prentki (Abstr. 2668 of 1956) for the strong interactions and assuming the baryons form a mass degenerate system in the absence of interaction, it is shown that the observed baryon mass spectrum is consistent with values of the coupling constants suggested by dynamical processes, such as π—nucleon and K^+—nucleon scattering. The π—baryon interaction has been taken to be of the $(\sigma\cdot\nabla)$ type and the K—baryon interaction to be of the γ_5 type; the Rayleigh—Ritz method using a simple one-meson trial wave function is used to calculate the masses.

539.11

20044 APPLICABILITY CONDITIONS OF THE HYDRODYNAMICAL MODEL OF MULTIPLE PRODUCTION OF PARTICLES FROM THE POINT OF VIEW OF QUANTUM FIELD THEORY. C.Iso, K.Mori and M.Namiki.
Progr. theor. Phys., Vol. 22, No. 3, 403-29 (Sept., 1959).

In the framework of quantum field theory, it is attempted to investigate whether the hydrodynamical description is applicable to the meson cloud produced in extremely high-energy collision of nucleons as considered in Landau's theory of the multiple production of particles. Conditions for applicability of the hydrodynamical model consist of local equilibrium and conditions for the possibility of defining the local system in the meson cloud, which are prepared by the methods based on quantum statistical mechanics of irreversible processes. These conditions are examined by comparison of the correlation lengths and the relaxation times of the meson fluid with a characteristic length and time, in which the thermodynamical parameters, the temperature for example, of the fluid decrease or increase by an appreciable amount on a macroscopic scale. From such examinations it may be concluded that the hydrodynamical model holds almost everywhere except in the front part of the cloud after the whole cloud spreads over a region whose size is the order of the correlation length. It is, however, emphasized that the interactions in the initial cloud directly after collision and in the front part of the expanding cloud can never be described by any statistical law or hydrodynamics. The fact that the front particles are never in any thermal equilibrium suggests that they remember some features of initial high energy interactions in the very small cloud. In other words, it is inferred that the distributions (for example, K/π ratio and the momentum or angular distribution) of the front particles may give information about the interactions at very small distances. On the other hand the influences of initial interactions on the remaining cloud are only taken into account through the initial boundary conditions for the hydrodynamical equation. It is pointed out that the assumption of the perfect fluid used by Landau is not so good — one can expect an increment of the number of particles through the final interactions. Comparisons are made with experiment.

539.11

20045 ON THE STRONG INTERACTION. H.Miyazawa, T.Nakano and H.Umezawa.
Progr. theor. Phys., Vol. 22, No. 5, 643-6 (Nov., 1959).

A model for the strong baryon—meson interaction is proposed, and consequence is discussed.

539.11

20046 SOLUTION OF THE DIRAC EQUATION FOR ELECTROMAGNETIC POTENTIALS.
N.C.Rastogi and Vachaspati.
Proc. Indian Acad. Sci. A, Vol. 50, No. 3, 202-5 (Sept., 1959).

Following Eliezer (Abstr. 2786 of 1958), the Dirac electron equation for electromagnetic potentials is solved. Explicit symmetrical expressions are obtained for the potentials in terms of the electron wave-function, its derivatives and a linear combination of the potentials.

539.

20047 REMARKS ON THE TRANSFORMATION PROPERT OF THE DIRAC EQUATION. P.Y.Pac.
Progr. theor. Phys., Vol. 22, No. 6, 857-62 (Dec., 1959).

The physical properties of dynamical variables in the extre relativistic representation are discussed. Especially, it is point out that care must be taken in the choice of the proper "mean" p sition; the results include those of Bose, Gamba and Sudarshan (Abstr. 6524 of 1959) as special cases.

539

20048 TRANSFORMATION GROUPS AND SOLUTIONS OF DIRAC'S EQUATIONS. K.H.Tzou.
J. Phys. Radium, Vol. 20, No. 6, 597-605 (June, 1959). In Frenc

By considering the transformation groups as simple substitu of variables e, r, t, it is shown that, from a given solution of Dir equations, the symmetry group G (composed of P, T, C and combinations) and the proper or continuous Lorentz group L can generate all solutions of these equations satisfying the same phys conditions as does the original solution, if G and L are entirely applicable. Identification of the solutions produced proceeds according to certain rules depending upon the constants of motio the problem considered. Two examples are studied for illustrati the monochromatic plane wave and the central field problem. Th identification is further stated precisely concerning the two spin values. All states of an electron are thus connected one to anoth by the groups G and L. The behaviour of the solutions under spa reflection is studied. Finally, a general solution is constructed, which is invariant against the operations of the groups G and L, one can express in this way the usual procedure of Fourier expar according to the group concept. Some remarks have been made possible solutions invariant against C, CP and CPT.

539.

20049 TWO-COMPONENT SPINOR FIELDS FOR DESCRIB ARBITRARY SPIN-½ PARTICLES AND THEIR APPL CATION TO WEAK INTERACTIONS. W.R.Theis.
Fortschr. Phys., Vol. 7, No. 10-11, 559-83 (1959). In German.

A relativistic field theory for arbitrary spin-$\frac{1}{2}$ of particles given that contains only two-component field operators. Traditional and well proved arguments of simplicity for the choice of interactions of these fields yield an almost unique and therefore universal, four-fermion interaction which violates parity in a definite way. The resulting couplings already published (see Ab 7691 of 1958) are the same as those of Feynman and Gell-Mann, others.

539.

20050 THE KEMMER β-FORMALISM FOR PARTICLES OF SPIN ONE-HALF. A.O.Barut and M.Samiullah.
Nuovo Cimento, Vol. 17, No. 6, 876-80 (Sept. 16, 1960).

A linearization of the two-component second-order spinor e tion of Feynman and Gell-Mann for spin one-half particles leads a ten component equation of the Kemmer type. Up to now such equations were only known for integral spin particles.

53

20051 MULTIPOLE MODEL OF ELEMENTARY PARTICL I. PION—BARYON INTERACTIONS.
D.Ito, S.Minami and H.Tanaka.
Progr. theor. Phys., Vol. 22, No. 2, 159-67 (Aug., 1959).

A simple model is presented for a unified understanding of particle phenomena. In the case of the pion—baryon system the strong interaction is interpreted as the monopole interaction and the weak interaction as the dipole interaction between pions and structured baryons of order 10^{-20} cm. The nature of the weak interaction is discussed on the basis of the multipole model.

53

20052 MULTIPOLE MODEL OF ELEMENTARY PARTICL II. NON CONSERVATION OF PARITY AND BARYON LEPTON INTERACTIONS.

D), S.Minami, H.Tanaka, Y.Takahashi and M.Yamazaki.
P gr. theor. Phys., Vol. 22, No. 2, 168-76 (Aug., 1959).

The problems of the nonconservation of parity and the universal F ni interaction are discussed on the basis of the multipole n el. Nonconservation of parity comes from the asymmetric s cture in the small region of order 10^{-20} cm. The coupling length 10^{-17} cm in the β-decay is derived from the interaction of the z erbewegung baryons and extended leptons of order 10^{-20} cm. oupling becomes, however, of axial vector type instead of v or-axial vector type.

539.11

0053 A POSSIBLE SYMMETRY IN SAKATA'S MODEL FOR BOSONS-BARYONS SYSTEM.

keda, S.Ogawa and Y.Ohnuki.
gr. theor. Phys., Vol. 22, No. 5, 715-24 (Nov., 1959).

A possible symmetry in Sakata's model (Abstr. 6884 of 1957) for strongly interacting particles is studied. In the limiting case in ch the basic particles p, n, and Λ have equal mass, the theory ains the invariance under the exchange of p and Λ or n and Λ in ition to the usual charge independence and the conservation of ctrical and hyperonic charge. From this theory the following are ained: (a) the iso-singlet $\pi_0{}'$-meson state, which is a pseudoscalar, sts, (b) the spin of Ξ may be $\frac{3}{2}^+$ and (c) several resonating states K- and π-nucleon scattering are anticipated to exist.

539.11 : 539.12

COMPOSITE MODEL OF BARYONS AND MESONS. See str. 20203

539.11

20054 SPIN FLIP OF A RELATIVISTIC PARTICLE WITH A MAGNETIC MOMENT MOVING IN AN EXTERNAL FIELD.

.Popov.
eksper. teor. Fiz., Vol. 38, No. 5, 1584-8 (1960). In Russian.

The problem of rotation of the spin of a relativistic particle a magnetic dipole moment moving in an external electro- gnetic field is solved. The angular velocity of rotation of the n is determined in the rest system of a particle rigidly fixed to trajectory (analogue of Fresnet trihedron for a four-dimensional ve). The results obtained are significant in measurements of the gnetic and electric moments of elementary particles.

539.11

20055 UNITARITY CONDITIONS FOR BINARY PROCESSES INVOLVING PARTICLES OF ARBITRARY SPIN.

J.MacFarlane.
clear Phys., Vol. 18, No. 4, 570-4 (Sept. (2), 1960).

Using the helicity description of two-particle eigenstates of tal angular momentum, it is found that a concise statement can be tained of the unitarity condition, in the two-particle approximation, r processes of type A + B → C + D involving particles of arbitrary in. As an illustration of the use of this statement a specific set of ocesses is discussed and some remarks are made about its plication below the physical threshold.

539.11

20056 SECOND-ORDER EQUATIONS FOR SPINOR FIELDS.

V.S.Vanyashin.
h. eksper. teor. Fiz., Vol. 39, No. 2(8), 337-9 (Aug., 1960).
Russian.

Second-order wave-equations for fermions are investigated on e basis of the Lagrangian formalism. It is shown that an dditional degree of freedom of the particles is due to two orien- ations of the imaginary electric dipole moments, which may ossess, however, a vacuum real part.

539.11 : 530.12

20057 ABSENCE OF BOUND STATES IN A GRAVITATIONAL FIELD. A.Peres.

hys. Rev., Vol. 120, No. 3, 1044 (Nov. 1, 1960).

The Klein—Gordon and Dirac equations for a particle in the ravitational field of a point mass are investigated. It is shown hat the geometrical properties of the Schwarzschild metric revent the normalization of any bound-state solutions.

539.11

20058 DISTRIBUTION-THEORETIC OBSERVATION ON THE BORN SCATTERING FORMULA (FIRST APPROXIMATION). P.K.Ghosh.

Bull. Calcutta Math. Soc., Vol. 51, No. 4, 199-201 (Dec., 1959).

Discusses what type of scattering potentials V(r) would give mathematically meaningful results for the Born formula for scattering (in the first approximation). Schwartz' theory of distributions is invoked.

539.11

20059 ON THE AZIMUTHAL ASYMMETRY IN THE SCATTERING OF DIRAC PARTICLES. R.M.Muradyan.

Dokl. Akad. Nauk SSSR, Vol. 131, No. 5, 1057-9 (April 11, 1960).
In Russian.

The scattering of a beam of polarized particles by an arbitrary spherically symmetric potential is considered. Assuming the values of the phase shifts to be known in lowest order, the polarization $D(\theta) = i[f(\theta)g^*(\theta) - g(\theta)f^*(\theta)]$ is calculated. The resulting azimuthal asymmetry is discussed. R.F.Peierls

539.11

20060 CALCULATION OF THE SCATTERING PHASE SHIFTS. V.K.Peterson.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1525-7 (1960). In Russian.

A method is proposed for calculation of the phase shifts of particles in a centrally symmetric potential field. The case is considered when the phase shift can be expressed as a series of powers of a constant which characterizes the dimensions of the potential well.

539.11

20061 DISTORTED WAVE APPROXIMATION FOR SCATTERING PHASE-SHIFTS. P.Swan.

Nature (London), Vol. 187, 585-6 (Aug. 13, 1960).

Proposes a method of allowing approximately for wave-function distortion when calculating phase shifts from a potential.
R.J.N.Phillips

539.11

20062 ON THE MINIMUM NUMBER OF PARTIAL WAVES IN TWO-BODY REACTIONS.

V.G.Grishin and V.I.Ogievetski.
Nuclear Phys., Vol. 18, No. 3, 516-20 (Sept. (1), 1960).

A reliable method is offered for determination of the minimum number of partial waves involved in the two-body interaction, if the total elastic cross-section and differential cross-section at a given angle are known.

539.11

20063 A METHOD FOR CALCULATING SCATTERING PHASE SHIFTS. J.N.Lyness.

Nuclear Phys., Vol. 18, No. 4, 654-68 (Sept. (2), 1960).

A method, based on perturbation theory, is derived for obtaining the reflection coefficient for scattering a plane wave by a potential well of a particular type. This type is an extension of a simple potential well, whose reflection coefficient is known. This method has the advantage that exact limits can be placed on the possible error due to using the perturbation expansion. A possible application is the exact determination of the effect on the cross-section of a "tail" added to a potential well.

539.11

20064 AN EQUIVALENCE THEOREM FOR PARTIALLY GAUGE-INVARIANT VECTOR MESON INTERACTIONS.

A.Salam.
Nuclear Phys., Vol. 18, No. 4, 681-90 (Sept. (2), 1960).

Consider a massive neutral vector meson U_μ interacting with other spin zero or spin $\frac{1}{2}$ particles ϕ. If the interaction Lagrangian consists of two parts $L_1(\phi,U) + L_2(\phi)$ where $L_1(\phi,U)$ is (together with kinetic energy terms) invariant for the gauge transformations

$$\phi = \exp(iQ\Lambda)\phi', \quad U_\mu = A_\mu - \frac{1}{\kappa}\frac{\partial\Lambda}{\partial x_\mu}$$

and L_2 is not gauge-invariant, it is shown that the conventional S-matrix $T\exp i(\int L_1(\phi,U) + L_2(\phi)$ identically equals

T exp i($L_1(\phi,A) + L_2(\phi')$). Since all Λ-dependent effects are now contained and displayed explicitly in $L_2(\phi')$ it is possible to give a precise discussion of the renormalization problem for vector meson theories. This is because the suspected non-renormalizability of these theories arises from $\partial\Lambda/\partial x_\mu$ terms in the conventional S-matrix. See also following abstract.

539.11

20065 ON SALAM'S EQUIVALENCE THEOREM IN VECTOR MESON THEORY. S.Kamefuchi.

Nuclear Phys., Vol. 18, No. 4, 691-6 (Sept. (2), 1960).

A simple proof is given of the equivalence theorem discussed by Salam (see preceding abstract). Some comments are also made on renormalizability of vector meson fields.

539.11

20066 DIVERGENCE-FREE ITERATIVE EXPANSION OF THE S MATRIX IN A FIELD THEORY. K.Haller.

Phys. Rev., Vol. 120, No. 3, 1045-57 (Nov. 1, 1960).

A new method is proposed for evaluating the S-matrix as a series expansion in powers of the coupling constant. The method is applicable to field theories which in the usual formulation have ultraviolet divergences in self-energy and vertex parts and require self-energy, coupling constant, and wave-function renormalization. The procedure cannot be applied in its present form to theories which allow boson self-energy terms. In this new procedure the usual form of the Hamiltonian for the coupled system is retained. The theory results in an iterated solution in powers of the physical coupling constant and yields a series, each term of which is finite without subtractions or renormalization. It agrees up to all orders examined with the finite S-matrix elements obtained by renormalizing the old formulation of the scattering problem. It is also shown that the n-th order contribution to the iterative expansion of the S matrix, where n is any order, approaches 0 more rapidly, at high energy, than $E^{-(2-\delta)}$ where δ is any positive real number, no matter how small.

539.11

20067 GENERALIZED ANGULAR MOMENTUM IN MANY-BODY COLLISIONS. F.T.Smith.

Phys. Rev., Vol. 120, No. 3, 1058-69 (Nov. 1, 1960).

With short-range forces, initial and final states in a classical 3-body collision are straight-line trajectories into and out of a region where all three particles are close together at the same time. Using six coordinates, three describing the relative position of a pair of particles, and three the relative position of the third particle and the centre of mass of the pair, the condition for simultaneous togetherness can be expressed with the help of the 6 × 6 grand angular momentum tensor, $\vec{\Lambda}$, whose components are

$$\Lambda_{ij} = (m_i/m_j)^{1/2} x_i p_j - (m_j/m_i)^{1/2} x_j p_i .$$

For a close 3-body collision $\Lambda^2 = \frac{1}{2} \Sigma_i {}_j \Lambda_{ij}^2$ must be small. Λ^2 commutes with the ordinary angular momentum operators and with the kinetic energy; its eigenvalues are $\lambda(\lambda + 4)\hbar^2$, with integral λ, and its eigenfunctions hyperspherical harmonics. Initial and final 3-body states can be described quantally by the total energy E, Λ^2, and a commuting set of ordinary angular momenta; this description has the same relation to a momentum representation as the ordinary angular momentum analysis has for a 2-body collision. A collision of (N+1) particles can be described by using a hierarchy of operators $\Lambda_n^2 (2 \leq n \leq N)$; their eigenvalues are $\lambda_n(\lambda_n + 3n-2)\hbar^2$.

539.11

20068 COMPLEX SINGULARITIES OF PARTIAL-WAVE AMPLITUDES IN PERTURBATION THEORY.

J.G.Taylor and A.E.A.Warburton.

Phys. Rev., Vol. 120, No. 4, 1506-7 (Nov. 15, 1960).

It is shown that the complex singularities which invalidate Mandelstam's representation (Abstr. 4941 of 1959) doe not cause complex singularities of partial-wave amplitudes for two-particle scattering processes, except for the expected "kinematic" complex branch points.

539.11

20069 RELATIVISTICALLY COVARIANT SPIN STRUCTURE OF THE S-MATRIX. V.I.Ritus.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1489-98 (1960). In Russian.

Relativistically covariant spin structure of the S-matrix is considered for the reactions $a + b \to a' + b'$, $\gamma + b \to a' + b'$, $\gamma + b \to \gamma' + b'$, $a + b \to 2\gamma$. The S-matrix is represented in a form in which the separate terms correspond to transitions between states with definite initial and final spins of the system.

539.1

20070 THE STRUCTURE OF A NON-RELATIVISTIC S-MATRIX. K.J.Le Couteur.

Proc. Roy. Soc. A, Vol. 256, 115-27 (May 31, 1960).

The S-matrix for the non-relativistic scattering of a particle by a target possessing discrete excited states is considered. Assuming the S-matrix to be an analytic function of the energy, the unitarity and reversibility conditions are extended into the complex plane, and it is shown how all the elements of the S-matri can be constructed from a single function P(k, K, L...) of the momenta of the particle in the various channels, which has zeros at the poles of S. For the two-channel problem the S-matrix is constructed explicitly from the positions of its poles in the complex plane together with conditions at ∞, and necessary conditions on the number and positions of the poles are formulated.

539.11

20071 ON LEVINSON'S THEOREM IN THE THEORY OF MULTI-CHANNEL SCATTERING.

G.Konisi and T.Ogimoto.

Progr. theor. Phys., Vol. 22, No. 6, 807-13 (Dec., 1959).

Using a Lee-type model, Levinson's theorem (Abstr. 5961 of 1949) is investigated in the case of multichannel scattering. Contrary to the case of potential scatterings or Dyson's model, Levinson's theorem becomes ambiguous in interpreting the physical meaning of the result obtained.

539.11 : 539.1

20072 TWO-NUCLEON POTENTIAL WITH THE "ONE-PION-EXCHANGE TAIL".

T.Hamada, J.Iwadare, S.Otsuki, R.Tamagaki and W.Watari.

Progr. theor. Phys., Vol. 22, No. 4, 566-84 (Oct., 1959).

It is shown that p—p single and double scattering up to 150 Me can be reproduced by a potential with the "one-pion-exchange tail" in its outer part, without assuming any seriously energy-dependent interactions and spin—orbit coupling potentials. The intermediate part of the potential has all features that are characteristic of the two-pion-exchange potential. Qualitative reasoning of this potentia is given together with the results of calculation. [An erratum to this paper appears in ibid., Vol. 22, No. 5, 742 (Nov., 1959)].

539.1

20073 INVESTIGATION OF THE LIMITS OF APPLICABILITY OF THE IONIZATION LOSS THEORY.

M.L.Ter-Mikaelyan.

Zh. eksper. teor. Fiz., Vol. 38, No. 3, 895-905 (March, 1960).

In Russian.

The energy losses of an arbitrarily moving particle were computed with the aid of Maxwell's macroscopic equations. Separation into ionization losses and radiative losses was carried out without the use of perturbation theory. The effect of multiple Coulomb scattering and of finiteness of the trajectory length on the ionization loss formulae were considered. It was found that, because of the density effect, the influence of multiple Coulomb scattering on this part of the losses can be neglected.

539.1

20074 THE SCATTERING MATRIX TAKING INTO ACCOUNT THE PAULI INTERACTION.

L.G.Moroz and F.I.Fedorov.

Zh. eksper. teor. Fiz., Vol. 39, No.2(8), 293-303 (Aug., 1960).

In Russian.

A ten-dimensional formulation of electromagnetic field theory involving first-order equations is employed. Within the framewor of this formalism, an expression is derived for the quantum electr dynamic scattering matrix with allowance for the Pauli interaction Scalar-photons are not required in the theory. The states of a fre field longitudinal photon are used for the purpose of simplifying th calculations of the transition probabilities for unpolarized light.

539.11

20075 DISPERSION RELATIONS AND HIGH ENERGY LIMITS IN QUANTUM FIELD THEORY. S.Aramaki.

Progr. theor. Phys., Vol. 22, No. 4, 485-91 (Oct., 1959).

It is shown that the high-energy limits in quantum field theory be determined starting from Bogolyubov's and Symanzik's dis-sion relations(Abstr. 3966 of 1957) if the boson propagator and ıucleon forward scattering amplitude have no zero on their ıplex energy planes. A possibility excluding zeros is discussed ıg Nambu's method in perturbation theory.

539.11

20076

A NOTE ON THE PROOF OF DISPERSION RELATIONS.

A.Minguzzi and R.F.Streater.

ıvo Cimento, Vol. 17, No. 6, 946-50 (Sept. 16, 1960).

Lehmann's proof of dispersion relations is completed by wing that the absorptive part of the scattering amplitude is ular in a uniform neighbourhood of the real axis as a function of meson mass. The same point is considered for production pro-ıses; one or two other difficulties in the latter case are also cussed.

539.11 : 539.19

20077

DISPERSION RELATIONS AND THE ANALYSIS OF THE CROSS-SECTION DEPENDENCE NEAR THE THRESH- DS OF NEW REACTIONS.

.Lapidus and Chzhou Guan-Chzhao [Chou Kuang-Chao].

. eksper. teor. Fiz., Vol. 39, No. 1(7), 112-19 (July, 1960). In ssian.

The application of the dispersion relations to an analysis of the ɔendence of the scattering (and reaction) amplitudes near the esholds of new reactions is examined. General expressions are ained which characterize the nonmonotonic variation of the forward ıttering amplitude as a function of energy. The energy dependence one of the amplitudes for elastic scattering of γ-quanta by deuter-s near the photodisintegration threshold of the deuteron is con-lered.

539.11

20078

REMARK ON THE OPTICAL THEOREM.

D.Blokhintsev.

ı. eksper. teor. Fiz., Vol. 39, No. 4(10), 1153-4 (Oct., 1960). In ıssian.

A generalization of the relation

$$\mathrm{Im}\, f(0) = (k\sigma_T/4\pi)$$

derived for processes involving incoherent mixtures of pure states g. averaging over spin). It is shown that even when Re f(0) = 0 in ery channel, the forward scattering cross-section may exceed $\sigma_T/4\pi)^2$.

D.W.L.Sprung

539.11

20079

THE RENORMALIZATION CONSTANTS IN PERTURBATION THEORY.

J.G.Taylor.

uovo Cimento, Vol. 17, No. 5, 695-702 (Sept. 1, 1960).

A simple theory of products of distributions is applied to ıe perturbation expansions of quantum field theories. This product equires that all divergent momentum integrals be replaced by finite ut arbitrary constants. This product must be associative and ommutative, and this can be satisfied by suitable choices of the rbitrary constants. In renormalizable theories any remaining rbitrariness only appears in the mass and charge, but will appear ı other observables in non-renormalizable theories. These theories ow become mathematically consistent but only practically useful ɔr weak interactions.

539.11

20080

SOME PROPERTIES OF SINGLE LOOP DIAGRAMS IN PERTURBATION THEORY.

I.Fowler, P.V.Landshoff and R.W.Lardner.

uovo Cimento, Vol. 17, No. 6, 956-63 (Sept. 16, 1960).

Some analytic properties of single loop diagrams are discussed, nd in particular it is shown that it is not possible to set up a two-ariable spectral representation for production processes.

539.11

20081

ON THE SYSTEMS OF PARTICLES IN THE NON-RELATIVISTIC FUNCTIONAL THEORY.

.Aeschlimann.

. Phys. Radium, Vol. 20, No. 8-9, 730-5 (Aug.-Sept., 1959). n French.

A study of the general conditions required to set up a non-elativistical functional theory for systems of particles. Representation of each particle of a system is by a space-time function $u_j(P,T)$. Formal classification for the particles of the system is given with respect to indiscernability and the exclusion principle for the fermions. Using the general theory of predictions, the arguments of the functional for predictions are fixed, functional configuration-space is introduced and the general form of the equation for the predictional elements is determined. Conditions incurred by the limiting cases of the usual wave mechanics for systems and of the single particle in the functional theory of particles. The fundamental principle for the equations of motion concerning the particles of a system is that each function $u_j(P,T)$ describing a particle of the system obeys a non-linear equation which depends upon the functions $u_k(P,T)$ of the other particles of the system. A brief investigation of the limiting case of classical mechanics is given.

539.11

20082

GROUP THEORY OF HARMONIC OSCILLATORS. I. THE COLLECTIVE MODES.

V.Bargmann and M.Moshinsky.

Nuclear Phys., Vol. 18, No. 4, 697-712 (Sept. (2), 1960).

The present series of papers will deal with the classification of states of N particles moving in a harmonic oscillator common potential. This paper is mainly concerned with the classification scheme that brings out a collective nature of the states. To obtain this collective behaviour, advantage is taken of the invariance of the Hamiltonian under both ordinary rotations and the unitary group in N dimensions.

539.11 : 539.14

20083

NUCLEAR FORCES AND THE PROPERTIES OF NUCLEAR MATTER.

S.A.Moszkowski and B.L.Scott.

Ann. Phys. (New York), Vol. 11, No. 1, 65-115 (Sept., 1960).

The application of the Brueckner theory to the nuclear many-body problem can be greatly simplified if one separates the two-nucleon interaction (for any given state and relative momentum) into a short range part v_s and a long range part v_l. The cut is made such that v_s alone gives no phase shift for free particle scattering. If the separation is made in this way, then the presence of nuclear matter, as manifested by the Pauli principle, has only a small effect on the two-particle wave function at short distances. On the other hand, the Pauli principle drastically reduces the induced correlations due to v_l. In fact, v_l is the first approximation to the effective interaction in nuclear matter. This procedure permits one to systematically expand the effective interaction in terms of t_s, the reaction operator for free particles caused by v_s alone. The contribution of all first- and second-order terms to the binding energy of extended nuclear matter has been calculated numerically. Most of the work was done using a central spin-independent two-body interaction containing a hard core of radius 0.4 fermi followed by an attractive exponential well with parameters chosen to give infinite scattering length and intrinsic range 2.5 fermis. If the potential is assumed to act only in S-states, a minimum energy is obtained of −12 MeV per particle at a density corresponding to a nuclear radius 1.0 $A^{1/3}$ fermis. The largest of the second-order terms contributes only 5.4 MeV to the energy per particle at this density (as compared to −42 MeV for the first-order term) and the other second-order terms much less. Thus this expansion appears to converge fairly rapidly. The effect of changes in the well parameters has been investigated. Also, the present method was applied to interactions used by Gomes et al. (Abstr. 4258 of 1958), Brueckner and Gammel (Abstr. 2515 of 1958) and Tagami (Abstr. 17468 of 1960), and the results compared with some of those obtained by the authors.

539.11

20084

THE THEORY OF NUCLEAR MATTER.

G.M.Vagradov and D.A.Kirzhnits.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1499-506 (1960). In Russian.

A simple method is proposed for quantitative description of the ground state of nuclear matter. It is demonstrated that the gas approximation with a modified nucleon dispersion law can be employed in this case. The error of the method does not exceed that of the empirical quantities.

539.11

20085

THE MICROSCOPIC THEORY OF THE FERMI FLUID.

V.I.Karpman.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 185-8 (July, 1960). In Russian.

A relation is established between the Fermi excitation energies predicted by the Landau theory of the Fermi fluid and by the many-particle quantum theory at zero temperature.

539.11

20086 A GRAPHICAL TECHNIQUE FOR COMPUTATION OF KINETIC QUANTITIES. O.V.Konstantinov and V.I.Perel'.
Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 197-208 (July, 1960). In Russian.

A graphical technique is developed for the computation of the one-electron density matrix. A kinetic equation is deduced from quantum theory which takes into account the inhomogeneity of the external electric field and the self-consistent electron field.

539.11

20087 ON THE TREATMENT OF THE QUANTUM MECHANICAL MANY-PARTICLE PROBLEM WITH THE HELP OF SEVERAL-PARTICLE FUNCTIONS.
E.Kröner and F.Hofelich.
Z. Phys., Vol. 160, No. 3, 297-309 (1960). In German.

An inequality satisfied by L-particle density matrices of a system of N fermions is used to obtain a lower bound for the ground state energy of an N-particle system: this lower bound is found from the energies of stationary states of a related L-body problem. The method is best for a large value of the ratio L/N. The method is applied to the calculation of the ground state of an N-electron atom from the excited states of an (N−1)-electron atom, and the errors are found to be less than 1%. Generalization of the method to other problems is discussed. D.J.Thouless

ELEMENTARY PARTICLES

539.12

20088 ELEMENTARY PARTICLES. T.D.Lee.
Phys. Today, Vol. 13, No. 10, 30-6 (Oct., 1960).

Review article based on 29th Joseph Henry Lecture of the Philosophical Society of Washington delivered on 6 May 1960.

539.12

20089 ELEMENTARY PARTICLES AND SYMMETRY PRINCIPLES. M.A.Melvin.
Rev. mod. Phys., Vol. 32, No. 3, 477-518 (July, 1960).

Surveys the part played by symmetry principles in the theory of elementary particle properties and interactions. Includes an account of group concepts. R.J.N.Phillips

539.12 : 539.1.07

20090 DETERMINATION OF THE MASSES AND MOMENTA OF CHARGED PARTICLES FROM MULTIPLE SCATTERING MEASUREMENTS IN A PROPANE BUBBLE CHAMBER. V.G.Kirillov-Ugryumov, L.P.Kotenko, E.P.Kuznetsov and A.V.Samoilov.
Nuclear Instrum., Vol. 3, No. 5, 265-70 (Nov., 1958).

To measure a mass of the order of a π-meson or μ-meson mass with an accuracy of 30% it is sufficient to have a 36 cm range in propane; for near-protonic masses to the same accuracy, a range of 72 cm suffices. To measure a particle momentum of the order of 100 MeV with an accuracy of 15%, it is sufficient to have a range of 25 cm in propane.

539.12 : 523.8

NET ELECTRIC CHARGES ON STARS, GALAXIES AND "NEUTRAL" ELEMENTARY PARTICLES. See Abstr. 18789

539.12

20091 ON AN ESTIMATE OF THE MINIMUM PARTICLE INTERACTION RADIUS AT HIGH ENERGIES.
V.G.Grishin and V.I.Ogievetskii.
Zh. eksper. teor. Fiz., Vol. 38, No. 3, 1008-9 (March, 1960). In Russian.

An expression for the least number of partial waves necessary for a description of the experimental data is derived in terms of the total and differential cross-sections. This is connected quasi-classically with the least interaction radius. J.S.Dowker

539.12

20092 ON THE SIGNS OF THE CONSTANTS OF THE STRONG INTERACTION. I.Yu.Kobzarev and L.B.Okun'.
Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 210 (July, 1960). In Russian.

The strong interactions of the elementary particles N, π, Λ, Σ, Ξ, K are characterized by eight coupling constants, four of which arbitrary signs and the other four determined by experiment by e amination of the interference term with Coulomb scattering. J.H.G

539.

20093 EFFECT OF MULTIPLE SCATTERING ON THE INTRINSIC FIELD OF A FAST CHARGED PARTICLE.
F.F.Ternovskii.
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 491-6 (Aug., 1960). In Russian.

It is shown that the intrinsic field of a fast charged particle passing through a medium decreases at a higher rate with the increase of the distance from the axis of motion than in vacuum. This leads to the emission of radiation when the particle passes from one medium to another and affects direct pair-production.

539.12 : 539.

INTERFERENCE BETWEEN COULOMB AND NUCLEAR SCATTERING AT HIGH ENERGIES. See Abstr. 20429

539.

20094 DEPOLARIZATION DUE TO TARGET MOTION. A.E.Werbrouck.
Phys. Rev., Vol. 120, No. 4, 1463-7 (Nov. 15, 1960).

The projection upon both of the lab scattering planes of a spin component along the centre-of-mass angular momentum direction is computed for arbitrary target motion. The resulting depolarization of Λ hyperons produced by 1080 MeV/c pions on nuclear matter and on deuterons is presented as a function of production angle. At this energy, the polarization, if constant for all producti angles, would be reduced to 85% and 95% of the original value in he nuclei with respect to the π × Λ and K × Λ planes, respectively. I deuterium, the reductions would be to 98.4% and 99.5% of the initia polarization.

539.1

20095 PRODUCTION OF PARTICLE BEAMS AT VERY HIGH ENERGIES. S.D.Drell.
Phys. Rev. Letters, Vol. 5, No. 6, 278-81 (Sept. 15, 1960).

Argues, from the positions of poles in the transition amplitude that high-energy photons are very effective for generating collimated beams of high-energy charged particles. Predictions for pi production at 25 GeV compare favourably with estimates for production by protons. R.J.N.Philli

Photons

539.12

20096 ON THE ELASTIC SCATTERING OF PHOTONS BY THE COULOMB FIELD OF THE NUCLEUS.
K.Eftimiu, K.Vrezhoiu [C.Vrehoiu].
Zh. eksper. teor. Fiz., Vol. 38, No. 4, 1348-50 (April, 1960). In Russian.

Two methods are given for obtaining numerical results for elastic scattering of photons by the nuclear Coulomb field at large angles and lower energies than the conventional analytic approximations. R.F.Peierl

539.12 : 539.1.

USE OF BUBBLE CHAMBERS FOR EXPERIMENTS WITH HIGH ENERGY GAMMA-RAY BEAMS. See Abstr. 19981

539.

20097 CALCULATION OF THE PENETRATION OF GAMMA RAYS THROUGH THE EDGES OF A $\frac{1}{2}$-INCH DIAMETE LEAD COLLIMATOR. G.S.Cook.
Nuclear Instrum. and Methods, Vol. 4, No. 2, 103-6 (March, 1959)

Gamma radiation from a point radioactive source located on t axis of a cylindrically-shaped collimator is not sharply defined by the geometrical aperture of the collimator. Instead some of the radiation penetrates the edges of the collimator. Calculations of t magnitude of this penetration have been made for a 0.5 in. diamete cylindrical aperture in a lead collimator, from point sources 8, 9, 1.05, 13, 16, 32 and 48 in. from the detector end of the collimator. The results of these calculations are reported here.

539.12

098 **ON THE ACCURACY AND THE LIMITS OF APPLICABILITY OF THE DIFFUSION APPROXIMATION IN 3LEMS CONCERNED WITH THE PROPAGATION OF γ-RAYS.**
Voskoboinikov.
ekh. Fiz., Vol. 30, No. 1, 90-5 (Jan., 1960). In Russian.

Measurements are reported of the attenuation of γ-rays in sand vater with various concentrations of lead salts. Experimental lts obtained with Hg^{203} and Co^{60} sources indicate that the diffu- approximation can be used in very approximate calculations at .nces greater than about 2 mean free paths from the source. approximation is better for the softer γ-rays. S.Chomet

539.12

)099 **OPTICAL TRANSITION RADIATION FROM PROTONS ENTERING METAL SURFACES.**
ıldsmith and J.V.Jelley.
. Mag. (Eighth Ser.), Vol. 4, 836-44 (July, 1959).

Transition radiation is the term adopted to describe a feeble ation emitted when a charged particle crosses the boundary 'een two media having different optical properties. The paper :ribes experiments to establish the existence of this effect, :h has previously only been studied theoretically. The results, .ined from studies of the polarization of the radiation, its tation function and its absolute yield, confirm the predictions ıeory.

539.12

:0100 **INTERFERENCE EFFECTS OF BREMSSTRAHLUNG AND PAIR PRODUCTION IN CRYSTALS.** H.Überall.
ıvo Cimento Suppl., Vol. 6, No. 1, 315-21 (1957).

See Abstr. 461 of 1957.

539.12

20101 **OBSERVATION OF THE SUPPRESSION EFFECT ON BREMSSTRAHLUNG.**
I.Fowler, D.H.Perkins and K.Pinkau.
il. Mag. (Eighth Ser.), Vol. 4, 1030-4 (Sept., 1959).

The distance y between the primary pair of a photon-initiated scade and its first daughter pair was measured on 58 electro- ıgnetic showers of energy below 1000 BeV, and on 47 above 00 BeV. An average value of y of 10 mm was found for the low ergy group, in agreement with the predictions of the Bethe— itler and Migdal theories. For the high energy cascades the erage value for y was 13.5 mm, in agreement with the one pre- :ted by Migdal's calculations, and in disagreement with the value edicted by the Bethe—Heitler theory.

539.12

20102 **A RELATIVE MEASUREMENT OF THE CROSS-SECTION FOR BREMSSTRAHLUNG PRODUCTION FOR .5 MeV ELECTRONS IN GOLD, TANTALUM AND SILVER.**
J.Langmann.
Phys., Vol. 160, No. 2, 213-18 (1960). In German.

Relative production cross-sections were measured using the $\text{ı}^{63}(\gamma,n)\text{Cn}^{62}$ activation technique. No deviations from the theories Bethe and Heitler were detected, the experimental accuracy :ing ± 1.5%. R.H.Thomas

539.12

20103 **ON REACTION FORCES CAUSED BY CHERENKOV RADIATION IN CRYSTALS.** V.N.Kurdyumov.
okl. Akad. Nauk SSSR, Vol. 134, No. 3, 563-6 (Sept. 21, 1960).
ı Russian.

Expressions are derived for the forces causing deviations rom straight paths for electrons moving through a crystal, due ɔ asymmetries in the direction and intensity of the Cherenkov adiation. K.G.Major

X-rays

539.12 : 539.1.07

20104 **SOME EXPERIMENTS WITH METASTABLE LIQUIDS IN AN X-RAY BEAM.**
.A.Askar'yan, L.P.Kotenko, E.P.Kuznetsov and A.V.Samoilov.
h. eksper. teor. Fiz., Vol. 37, No. 5(11), 1469-70 (Nov., 1959). In ussian.

A successful attempt is reported to obtain a bubble-chamber nage of a solid object (a metal key) placed between an X-ray source 50 kV, 10 mA) and a propane bubble chamber (0.75 litre).
S.Chomet

539.12

20105 **ABSORPTION ANALYSIS OF X-RAY SPECTRA PRODUCED BY BERYLLIUM WINDOW TUBES OPERATED AT 20 TO 50 KVP.** E.A.Burke and R.M.Pettit.
Radiation Research, Vol. 13, No. 2, 271-85 (Aug., 1960).

It is shown that absorption analysis can be employed to determine the spectrum of an X-ray beam containing characteristic X-ray lines superimposed on the continuous spectrum. In order to analyse such beams it is necessary to collect absorption data on a second tube, identical to the first except for target material, and operated at the same voltage and current. The method was used to determine the spectra of four different X-ray tubes operated at three different voltages. It was found that the continuous spectrum could be represented by a simple function containing only two constants. One of the constants proved to be independent of tube target material and applied voltage; the other, a function of voltage only. The integrated intensity of the continuous radiation was found to vary directly as the atomic number of the tube target and the square of the voltage applied.

539.12

20106 **X-RAY ATTENUATION COEFFICIENTS FROM 10 keV TO MeV.** R.T.McGinnies.
Circ. Nat. Bur. Stand., No. 583, Suppl. 10 pp. (1959).

A revision of an earlier table. (See Abstr. 9229 of 1957).

539.12

20107 **400 kV-200 JOULE X-RAY FLASH TUBE.** J.Bernard and A.Rossignol.
J. Phys. Radium, Vol. 20, Suppl. No. 12, 167A-174A (Dec., 1959). In French.

Describes the study and perfecting of a fine focus X-ray flash tube. Its normal operating voltage is 400 kV for an energy of 200 joules. The methods used to record the curves of voltage and current and to measure the duration of X-ray flash are also given.

539.12

20108 **A NEW FINE FOCUS X-RAY TUBE.** Y.Kamiya.
J. Phys. Soc. Japan, Vol. 14, No. 10, 1327-33 (Oct., 1959).

The tube's electron gun has double wehnelt cylinders. The size of the X-ray source was measured by means of an X-ray pinhole camera. The size becomes very small for the positive value of the bias voltage on the inner cylinder with which the image of the filament is formed on the anode. The finest X-ray source obtained is 40μ in half-width and 400μ in length. The peak specific loading is about 8 × 10^5 W/cm^2 at the filament temperature 1700° K which assures long life of the filament.

539.12

20109 **MONITORING X-RAY TUBE OUTPUT WITH IONIZATION CHAMBER.** K.Tanaka, J.Chikawa and T.Yamanaka.
J. Phys. Soc. Japan, Vol. 14, No. 10, 1321-7 (Oct., 1959).

The intensity of an X-ray beam can be stabilized by using an ionization chamber as a monitor which is placed between an X-ray tube and a specimen. The filament current of the X-ray tube is controlled so as to keep the output potential of the ionization chamber constant. The ionization chamber was designed in consideration of the wavelength response and the statistical fluctuation of the output voltage. High stability of a demountable X-ray tube as well as of a sealed-off one was obtained without rigorous regulation of tube voltage. If an X-ray tube is operated at 40 kVp and the tube voltage is stabilized within ±0.1%, the fluctuation of intensity can be limited to ±0.1%. Then, the fluctuation of intensity in a broad diffraction line of a polycrystalline specimen which was measured for 5 hours could not be distinguished from the statistical fluctuation. The fluctuation of intensity in a diffraction line of a single crystal was ±0.2% for the sealed-off tube and ±0.5% for the demountable one.

539.12

20110 **PROBLEMS OF DEVELOPING A FILM METHOD FOR REGULARLY CHECKING RADIATION OUTPUT OF X-RAY MACHINES.** L.Stanton.
Radiology, Vol. 75, No. 3, 416-28 (Sept., 1960).

The requirements for obtaining quantitative dosage measurements from the irradiation of films by X-ray therapy units are discussed. The response of some commercial films to radiations from Co^{60} beams down to 120 kV X-rays are given. Procedures can be evolved to give reliable photographic results, but with most X-ray generators, a change in output is accompanied by an unpredictable change in quality. Ambiguity thus arises in interpreting the film density which is very dependent on quality of the X-ray beam. The effect is most marked in the heavily-filtered 250-300 kV range, and the film check on output is thereby limited to the low-energy X-ray range. The extent of likely errors with the common forms of X-ray generator is tabulated for 140-250 kV X-rays and many filtration conditions. D.V.Mabbs

539.12

20111

EXPERIMENTS ON INERTIALESS (FAST RESPONSE) MEASUREMENTS OF DOSE RATE NEAR COMMERCIAL X-RAY APPARATUS.

F.Buchmann, M.Höfert and R.Röhler.

Z. angew. Phys., Vol. 12, No. 8, 351-3 (Aug., 1960). In German.

A liquid scintillation counter (0.5 g terphenyl in 100 cm^3 of xylol), in combination with a photomultiplier, was used for dose rate measurements in the X-ray energy region 35-100 kV, the output signals being fed to an oscilloscope and photographed. The oscillogram areas were so normalized that the measurements at 85 kV coincided with those of a standard dosimeter obtained with equal exposure times. Due to the fast response of the cathode ray oscilloscope, short radiation pulses and rapid changes in dose rate could be resolved, the resolving time of the arrangement being 10^{-4} sec with a lower limit of 10^{-6} sec. The method was used to measure exposure times and dose rate variation near X-ray diagnostic apparatus. I.C.Demetsopoullos

539.12 : 533.6

FLASH X-RAY RADIOGRAPHY FOR THE DENSITY MEASUREMENT IN A HYPERSONIC AIR FLOW. See Abstr. 19188

539.12 : 535.8

SOLID-STATE X-RAY INTENSIFYING DEVICES. See Abstr. 19407-8

Electrons

539.12

20112

AN EXPERIMENTAL SEARCH FOR DIPOLE STRUCTURE OF THE ELECTRON.

G.R.Burleson and H.W.Kendall.

Nuclear Phys., Vol. 19, No. 1, 68-78 (Sept. (3), 1960).

By measuring the absolute cross-sections for the elastic scattering of electrons from the α-particle, the quantity $\alpha(q) = [\lambda^2(q) + \mu^2(q)]^{1/2}$ was found, where λ(q) and μ(q) are structure form factors of an electric dipole moment and an anomalous magnetic dipole moment of the electron. They are functions of the four-momentum transfer q. The result is $\alpha(Q) = (9.3 \pm 6) \times 10^{-5}\ e\hbar/m_0c$, with an additional uncertainty of $\pm 7 \times 10^{-5}(e\hbar/m_0c)$, for $Q \leq 2.25 \times 10^{13}$ cm. The experiment gave also the charge form factor of the α-particle. The data corresponded to the scattering from a Gaussian charge distribution having an r.m.s. radius of $(1.68 \pm 0.04) \times 10^{-13}$ cm.

539.12

20113

THEORY OF RADIATIVE PROCESSES IN PIECEWISE HOMOGENEOUS MEDIA.

F.F.Ternovskii.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 171-80 (July, 1960). In Russian.

The radiation emitted by an electron passing from vacuum into a semi-infinite medium is studied, taking into account multiple scattering and the polarization of the medium. The probabilities for bremsstrahlung and pair production by γ-quanta are computed for plates of finite thickness.

539.12 : 539.2

POSITRON LIFETIME IN METALS. See Abstr. 17908

539.12

20114

ONE-PHOTON ANNIHILATION AND ELECTRON PAIR PRODUCTION IN A MEDIUM.

G.S.Saakyan.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1593-6 (1960). In Russian.

One-photon annihilation and electron pair production ($e^+ + e^- \rightleftarrows \gamma$) may occur in a dispersive medium with a refractive index smaller than unity. In order for such processes to take place, the photon energy must lie in the interval $2m \leq \omega \leq N^{1/3}$, where m is the electron rest energy and N is the electron density in the medium. The probabilities for such processes are computed. The physical essence of these processes is similar to that of the Vavilov—Cherenkov effect. The processes under consideration dominate in the energy range $2m < \omega < 10m$.

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20115

POSITRONIUM DECAY IN MOLECULAR SUBSTAN

W.Brandt, S.Berko and W.W.Walker.

Phys. Rev., Vol. 120, No. 4, 1289-95 (Nov. 15, 1960).

The overlap of the positron component of the wave-function
positronium (Ps) in dense molecular substances with the lattice
wave-function determines the 2γ annihilation rate of positrons b
in orthopositronium via electron pickup from the lattice (τ_2 deca
and in part the 2γ angular correlation. Ps acts as a probe for t
dependence of one-particle wave-functions in lattices on structu
lattice parameters, and of radical-molecule interactions on ato
lattice parameters. To explore the sensitivity of this probe, Ps
wave-functions are calculated for different lattice structures in
Wigner—Seitz approximation, and the dependence of τ_2 decay on
lattice parameters is derived. This dependence was tested expe
mentally by τ_2 measurements on carefully characterized molecu
substances in different physical states. It is confirmed that the
temperature and state dependence is primarily a "free volume"
effect in the sense that the overlap between the Ps and lattice wa
functions decreases with increasing lattice spacing. The effects
a spherical confinement on the self-annihilation rates and stabili
of Ps are shown to be small for radii relevant to molecular lattic
An anomalous behaviour is found for the ice—water transition, w
τ_2 increases significantly despite the contraction of water betwee
the melting point and 4° C.

Nucleons

539

20116

ELECTROMAGNETIC STRUCTURE OF THE NUCLE I.

K.Hiida, N.Nakanishi, Y.Nogami and M.Uehara.

Progr. theor. Phys., Vol. 22, No. 2, 247-73 (Aug. 1, 1959).

The structure is investigated in detail. As regards its isovector part, the distribution functions of charge and anomalous
moment are obtained with use of two different methods, the seco
order relativistic perturbation and the static approximation: S-w
and recoil effects and highest-order corrections are examined b
comparing these results. The meson structure correction in the
fourth order perturbation is also calculated, and it is shown that
contribution is rather small. As for the isoscalar part, the
3π-state contribution is calculated by the lowest order perturbat
(order g^6), and its rough numerical evaluation is carried out. T
result obtained is favourable for explaining recent experimental
results, but not conclusive. Hyperon closed loop effects are als
discussed.

53

20117

ELECTROMAGNETIC STRUCTURE OF THE NUCL II.

K.Hiida, N.Nakanishi, Y.Nogami and M.Uehara.

Progr. theor. Phys., Vol. 22, No. 3, 351-72 (Sept., 1959).

The 3π-state contributions to the isoscalar part of nucleon
electromagnetic structure are explicitly calculated in the lowes
order of perturbation theory (order g^6). The detailed calculatio
techniques, numerical evaluations and approximation methods a
presented. The lowest order meson-structure correction to the
isovector part (order g^4) also is calculated in detail.

53

20118

ELECTROMAGNETIC STRUCTURE OF THE NUCLE III. STATIC LIMITS AND S-WAVE EFFECTS.

K.Hiida and N.Nakanishi.

Progr. theor. Phys., Vol. 22, No. 6, 863-81 (Dec., 1959).

The static limits of the 3π-state contribution (lowest order)
the electromagnetic structure of the nucleon are explicitly calculated. By comparing these with the results of Bosco and De Alfa
(Abstr. 12546 of 1959), the S-wave effect on the isoscalar part is
investigated in detail, and it is shown that the S-wave effect is
quite small (always less than 20%). Numerical evaluations of
$\lim \langle r^2 \rangle_{1,2}{}^S$, etc., also are carried out, but the numerical values
too sensitive to cut-off methods to draw any quantitative conclusi

53

20119

COUPLING CONSTANTS IN β-DECAY AND NUCLE STRUCTURE.

M.Nakagawa.

Progr. theor. Phys., Vol. 22, No. 5, 725-35 (Nov., 1959).

The difficulty concerning the renormalized axial vector cou
constant of β-decay with pionic corrections is analysed from a
simple model of nucleon structure. In this model, the nucleon i

ed to consist of the nucleon core of spin $\frac{1}{2}$ and the pionic and the core is assumed to be composed of a static bare, nsemble. An attempt is made to determine what restrictions posed on the wave functional of the nucleon core by the known of β-decay coupling constants. In the case in which the states bare particle are restricted to s- and p-state, it is found that ee-body configurations (NN$\bar{N}$) play the predominant role in to yield the maximum value of G_A/G_V ($\cong$1.38), the ratio of the ector- to the vector-coupling constant of the nucleon core. this analysis, N—$\bar{N}$ configurations of iso-singlet and spin are shown to be predominant.

539.12

0120 CONTRIBUTION TO THE NON-LOCAL INTERACTION THEORY OF HEITLER AND ARNOUS. Y.Héno.

Phys. (Paris), Ser. 13, Vol. 5, No. 5-6, 655-705 (May-June, . In French.

The nucleon anomalous magnetic moments are calculated to d order, using two forms of this theory. The results are isfactory. R.J.N.Phillips

539.12

)121 NUCLEON—ANTINUCLEON INTERACTION IN THE NEW TAMM—DANCOFF APPROXIMATION.

Mitra and R.P.Saxena.

. Roy. Soc. A, Vol. 257, 59-73 (Aug. 23, 1960).

The nucleon—antinucleon (N—$\bar{N}$) problem is formulated in the Tamm—Dancoff (NTD) approximation in the lowest order, and ntegral equation for N—$\bar{N}$ scattering derived, taking account of the exchange and annihilation interactions.It is found convenient epresent the N—$\bar{N}$ wave-function as a 4 × 4 matrix, rather than usual 16 × 1 matrix for the nucleon—nucleon wave-function, and mplete correspondence is established between these two repre- ations. The divergences associated with the annihilation inter- on and their renormalization are discussed in detail in the owing paper (see following abstract). The integral equation with exchange interaction alone, is then separated into eigenstates ', J, L and S in the usual manner and the various phase shifts ined. The results of the following paper for the contribution of annihilation term are then used to calculated the complete phase ts from which the various cross-sections (scattering and charge hange) are derived. The results indicate that while the exchange n alone gives too small value for the total cross-sections versus rgy, inclusion of the annihilation interaction without renormali- on effects makes the cross-sections nearly three times larger those observed. On the other hand, inclusion of the finite ects of renormalization (which manifest themselves essentially a suppression of the virtual meson propagator) brings down these ss-sections to the order of magnitude of the observed ones.

539.12

20122 RENORMALIZATION FOR NUCLEON—ANTINUCLEON INTERACTION. A.N.Mitra and R.P.Saxena.

c. Roy. Soc. A, Vol. 257, 74-82 (Aug. 23, 1960).

The divergences associated with the integral equation for the leon—antinucleon (N—$\bar{N}$) interaction derived in the preceding er (see preceding abstract) are here analysed in detail. The blem is found to be quite similar to that discussed by Dalitz and son (1955) in connection with the π—N problem. The part of the ve-function representing the specific effects of the annihilation eraction is found to be expressed in terms of the so-called ver- operator and a meson propagator modified by self-energy ects. The vertex operator is then renormalized and the finite servable) effects of this renormalization on the N—$\bar{N}$ wave- ction evaluated. It is found that, unlike the case of π—N scat- ing where two different renormalization factors are needed for scribing s- and p-wave interactions, the present problem re- ires a unique renormalization constant covering both odd and en angular momentum states.

539.12

20123 ON THE CLOUD—CLOUD INTERACTION IN HIGH-ENERGY INELASTIC NUCLEON—NUCLEON LLISIONS. A.Krzywicki.

clear Phys., Vol. 17, No.4, 609-13 (July (2), 1960).

The role of the cloud—cloud interaction in the production of pions in high-energy (several GeV) peripheral N—N collisions examined. It is shown that the cloud—cloud interaction probably s not play any essential role in the process in question.

539.12

20124 AMBIGUITY IN THE MIXING PARAMETER FOR NUCLEON—NUCLEON SCATTERING. M.Kawaguchi.

Progr. theor. Phys., Vol. 22, No. 1, 147-8 (July, 1959).

Supplementary remarks to a paper by Zastavenko, Ryndin and Chou (Abstr. 9950 of 1959). P.K.Kabir

539.12

20125 NUCLEON—NUCLEON SCATTERING IN MOMENTUM SPACE: OPEP AS EXAMPLE. P.Signell.

Progr. theor. Phys., Vol. 22, No. 4, 492-8 (Oct., 1959).

A practical formalism is developed for treating nucleon—nucleon scattering in momentum space. The non-adiabatic one-pion exchange potential is used as an example.

539.12

20126 THE TRIPLET ODD STATE POTENTIAL OF THE TWO-NUCLEON SYSTEM.

T.Hamada, J.Iwadare, S.Otsuki, R.Tamagaki and W.Watari.

Progr. theor. Phys., Vol. 22, No. 2, 301-4 (Aug., 1959).

The cross-section and polarization data at 90 and 150 MeV are fitted by a static, central plus tensor potential, consistent with the low energy data. For radii greater than one meson Compton wave-length the one-pion exchange potential tail is used; inside this radius a hard core and two square wells of variable depth and radii were adjusted. The best fits at 90 and 150 MeV differ slightly. The phase shifts show strong tensor splitting. D.W.L.Sprung

539.12

20127 TWO NUCLEON PROBLEM AND DISPERSION RELATION IN NUCLEON—NUCLEON SCATTERING.

Y.Hara.

Progr. theor. Phys., Vol. 22, No. 6, 905-7 (Dec., 1959).

Given the scattering lengths, the singlet and triplet S-wave effective ranges were calculated from a low-energy approximation to the dispersion relations which neglects all contributions from higher waves. The dispersion integrals over the unphysical region were evaluated theoretically from the Feynman graphs.

D.W.L.Sprung

539.12

20128 APPLICATION OF CHARGE INDEPENDENCE TO ANNIHILATION OF ANTI-NUCLEONS. S.K.Srinivasan.

Proc. Nat Inst. Sci. India A, Vol. 25, No. 2, 99-103 (March, 1959).

The problem of annihilation of anti-nucleons by a nucleon is examined on the basis of the charge independence hypothesis. A table of ratios of π^+ to π^- to π^0 is presented for various multiplicities and comparison is made with the available data on anti-protons stars.

Protons

539.12

20129 A PRECISE MEASUREMENT OF THE MAGNETIC MOMENT OF THE PROTON. J.H.Sanders.

Nuovo Cimento Suppl., Vol. 6, No. 1, 242-5 (1957).

A new measurement of the magnetic moment of the proton was made by determining the ratio in the same uniform magnetic field of the proton spin precession frequency ν_n to the cyclotron frequency ν_c. μ_p (nuclear magnetons) = ν_n/ν_c. A field constant to 1 part in 60 000 over a circular region 12 cm in diameter was obtained and stabilized by means of a proton resonance signal. ν_n was obtained from this after correction for the diamagnetism of water molecules. A three-electrode geometry coupled to a variable frequency r. f. oscillator operating at a frequency near the 8th harmonic of ν_c was used to decelerate protons injected at 9.5 keV energy and ν_c deduced from measurements of the frequency for which protons reached an orbit radius of 4 cm, which was the minimum possible with this arrangment. The result obtained was μ_p = (2.79281 ± 0.00004) nuclear magnetons.

R.E.Meads

539.12

20130 A NEW MEASUREMENT OF THE GYROMAGNETIC RATIO OF THE PROTON. F.Kirchner and W.Wilhelmy.

Nuovo Cimento. Suppl., Vol. 6, No. 1, 246-53 (1957). In German.

The value $\gamma = 2.675\ 43 \times 10^4$ gauss^{-1} sec^{-1} was obtained.

R.H.Thomas

539.12

20131 ASSOCIATED PRODUCTION IN PROTON–PROTON COLLISIONS. E.Ferrari.

Phys. Rev., Vol. 120, No. 3, 988-92 (Nov. 1, 1960).

The simplest reactions of associated production in proton–proton collisions are investigated with the aid of two simple models, which consider as relevant only the contribution due to the exchange by one intermediate π-meson or K-meson, respectively. The values of the total cross-sections predicted by these models are calculated at various energies up to 3.5 GeV of the incident proton in the lab. system. These cross-sections are related to the experimental cross-sections for simpler processes, namely associated production by pions (first model) and K^+–nucleon scattering (second model). Both models give the same order of magnitude for the cross-sections for all reactions (10^{-2} mb at lower energies, 10^{-1} mb at higher energies), except for Σ^0 production, where the results predicted by the two models differ by a factor of 10. Some of the calculated values are affected by large errors, due to the uncertainty of the experimental data which are used.

539.12

20132 BREMSSTRAHLUNG FROM A DISTRIBUTED PROTON. N.A.Guliev and E.M.Epstein.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 432-3 (Aug., 1960). In Russian.

An expression is obtained for the form factor of a proton emitting bremsstrahlung radiation as a result of diffraction scattering in the field of a nucleus.

539.12

20133 BOUNDARY CONDITION MODEL FOR PROTON–PROTON SCATTERING.

D.P.Saylor, R.A.Bryan and R.E.Marshak.

Phys. Rev. Letters, Vol. 5, No. 6, 266-8 (Sept. 15, 1960).

The TMO potential tails are used with a boundary condition at 0.53 ħ/μc for singlet states and 0.56 ħ/μc for triplet states. Comparison with experiment are shown for dσ/dΩ, P, D, R and A at various energies between 40 and 310 MeV. The method was also tried with an OPEP tail and results are compared for dσ/dΩ at 147 MeV. A.Ashmore

539.12 : 539.17

QUASI-FREE PROTON–PROTON SCATTERING. See Abstr. 20447

539.12

20134 ELASTIC SCATTERING OF 8.5 BeV PROTONS ON PROTONS.

P.K.Markov, E.N.Tsÿganov, M.G.Shafranova and B.A.Shakhbazyan.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1471-5 (1960). In Russian.

Elastic p–p scattering at an energy of 8.5 BeV was studied by the photographic-emulsion technique. The irradiation geometry employed was such that the incident proton beam was directed perpendicular to the photographic emulsion plane. One hundred and forty five elastic scattering events were detected of which 66 were previously reported (Abstr. 11167 of 1960). The contributions of scattering on quasi-free protons and of other "background" events comprise ~1%. The total elastic scattering cross-section, equal to (8.6 ± 0.8) mb, and the differential cross-section down to 1° in the c.m.s. were obtained. The results could be made consistent with the homogeneous semitransparent sphere model with a refractive index not equal to unity.

539.12 : 539.17

20135 QUASI-ELASTIC PROTON–PROTON SCATTERING AT 158 MeV. B.Gottschalk and K.Strauch.

Phys. Rev., Vol. 120, No. 3, 1005-12 (Nov. 1, 1960).

The cross-section in impulse approximation for a quasi-elastic proton–proton scattering reaction with a bound target proton depends on the probability of finding inside the nucleus a proton with a momentum equal to the momentum transfer required by kinematics. This momentum transfer is determined if the incident energy and the energies and angles of the two outgoing partners of a proton pair are measured. Events involving s and p protons can be experimentally distinguished by noting that more energy is required to remove an s proton from the nucleus than a p proton. Thus the momentum eigenfunctions of each state can be explored experimentally by varying the momentum transfer, keeping constant the energy sum of a proton pair. Two methods of doing this to bring out the difference between scattering from s and p protons are discussed. They are (1) examination of the distribution of event
a function of the energy sharing between the two outgoing proton
fixed scattering angles, and (2) examination of the angular distri-
tion of events having fixed sharing. Born approximation calculat
are presented for predicting the regions of maximum sensitivity
differences between s and p protons. These predictions are used
the design of two experiments on the reaction $C^{12}(p,2p)B^{11}$ whose results are reported. They show good qualitative agreement wit
the predictions for p protons, namely that the sharing will tend t
unequal if the scattering angle of each proton is near 45° [type (1
experiment] and that the angular distribution of events of equal
sharing will have a minimum at 45° [type (2) experiment]. The predicted behaviour (opposite to that for p protons) for events involving s protons is not observed, and this fact is discussed in
light of possible inadequacies of the theory or of the experiment.

53

20136 ASYMMETRY IN THE ELASTIC SCATTERING OF POLARIZED PROTONS BY DEUTERIUM.

S.M.Marcowitz.

Phys. Rev., Vol. 120, No. 3, 891-900 (Nov. 1, 1960).

Asymmetries were measured at 419 MeV at proton centre-o
mass angles from 47.9° to 115°. The inferred polarizations are
−0.092 ± 0.058 at 47.9°, −0.502 ± 0.058 at 59°, −0.583 ± 0.081 at
68°, −0.141 ± 0.056 at 77.8°, −0.122 ± 0.111 at 90°, −0.150 ± 0.0
at 97°, −0.309 ± 0.073 at 105°, and +0.174 ± 0.059 at 115°. It is
suggested that using the impulse approximation these results ma
serve as a test of nucleon–nucleon scattering phase shifts or, wi
proton–proton scattering data, may be used to obtain I = 0 nucle
nucleon phase shifts.

539.

20137 ELASTIC γ–P SCATTERING AT 40 TO 70 MeV AND POLARIZABILITY OF THE PROTON.

V.I.Goldansky, O.A.Karpukhin, A.V.Kutsenko and V.V.Pavlovskay

Nuclear Phys., Vol. 18, No. 3, 473-91 (Sept. (1), 1960).

The elastic γ–p scattering at 40 to 70 MeV was studied and
the differential cross-sections were determined for angles of 45°
75°, 90°, 120°, 135° and 150°. The results thus obtained were com
pared with the Rayleigh–Powell scattering theory taking account
of the anomalous magnetic moment of the proton as well as the
effects of meson cloud polarization. Study of the forward scatter
cross-section, calculated through dispersion relations and the
angular distribution at 75° to 150° obtained from experiment,
warrants the conclusion that electric polarizability of the proton
$\alpha_E = (9 \pm 2) \times 10^{-43}$ cm^3 and its magnetic polarizability is
$\alpha_M = (2 \mp 2) \times 10^{-43}$ cm^3. This value of the proton electric polar
zability corresponds to the mean quadratic fluctuation of electric
dipole equal to $(3.5 - 5) \times 10^{-14}$ cm.

539

20138 ON THE THEORY OF p–α SCATTERING. A.Herzenberg and E.J.Squires.

Nuclear Phys., Vol. 19, No. 3, 280-98 (Oct. (3), 1960).

The differential cross-section for p–α scattering at 40 and
95 MeV was calculated with simple Gaussian internucleon potenti
Effects due to distortion of the α-particle and to the antisymmetr
of the wave-function were included and shown to be essential in
fitting the qualitative features of the experimental cross-sections
The results suggested a resolution of difficulties which were
encountered in recent attempts to calculate nucleon–nucleus
scattering from nucleon–nucleon phase shifts, by means of multi
incoherent scattering effects which occur when centre-of-mass
motion is treated correctly.

539

20139 THE INTERACTION OF 970 MeV PROTONS WITH HELIUM. L.Riddiford and A.Williams.

Proc. Roy. Soc. A, Vol. 257, 316-24 (Sept. 20, 1960).

The interaction of 970 MeV protons with helium was studied
with a high-pressure diffusion cloud chamber. From 642 events
the total and absorption cross-sections were found to be 116 ± 17
and 93 ± 13 mb, respectively. These agree with values obtained
extrapolation of known cross-sections for more complex nuclei,
the results are interpreted in terms of the optical model of the
nucleus. The angular distribution for elastic-scattering yields a
α-particle radius of 1.8 × 10^{-13} cm. Quasi-elastic proton–proto
and proton–neutron scattering, and more particularly charged
meson production, show that the α-particle has some individual
particle characteristics. Meson re-absorption appears unimport

539.12

:0140 ELASTIC SCATTERING OF PROTONS BY HELIUM BETWEEN 9.2 MeV AND 14.5 MeV. J.Sanada.

hys. Soc. Japan, Vol. 14, No. 11, 1463-71 (Nov., 1959).

The scattering of protons by helium has been investigated from MeV to 14.5 MeV with the INSJ variable-energy 160 cm cyclotron. full angular distribution curves were taken at 12.04 and 2 MeV. Both curves have a minimum at 115° and show the evi- :e of Coulomb nuclear interference, though very small, at ~ 18° ıe centre-of-mass system. Tentative phase shift analysis has ı made. It was found that the D-wave phase shifts are closely .ted with the shape of angular distribution at forward angles and are small but cannot be neglected. Excitation curves between and 14.5 MeV were also taken at four angles of 25°31', 49°21', ꞌ and 168°41' in the centre-of-mass system. The $k^2\sigma(\theta)$ versus rgy curves increase gradually with proton energy. They display ıew state in Li^5 except the $-\frac{1}{2}$ first excited state. The differen- cross-sections at energies near 9.5 MeV have served to resolve confliction between the values hitherto obtained.

539.12 : 537.56

20141 RELATIVE IONIZATION OF PROTONS NEAR THE END OF THEIR RANGE. H.Bichsel.

ys. Rev., Vol. 120, No. 3, 1012-14 (Nov. 1, 1960).

The influence of multiple scattering on straggling and conse- ently on the ionization produced by protons close to the end of ɜir range is derived. The effect due to nuclear reactions is shown be small at 340 MeV. The observed data at this energy are tisfactorily accounted for.

539.12 : 537.54

FINE TIME-STRUCTURE OF BEAMS FROM THE RMINGHAM PROTON SYNCHROTRON. See Abstr. 19844

539.12

20142 ON THE PROBLEM OF MEASURING PROTON CURRENTS.

Gërlikh, Ts.Kek, Kh. Krauze, A.Kros, E.Kh.Pol' and Kh.Shlott.
v. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 6, 668-72 (1960). In ıssian.

"Cathode electronics Conference" Moscow, 1959 (see Abstr. 022 of 1960). An investigation of the response of various photo- nsitive elements, both in combination with scintillators and alone, currents of protons varying from 10^{-8} to 2×10^{-7} A. Curves are ven to demonstrate the relation between the incident proton ırrent and the output currents from the arrangements.

J.E.Gore

539.12

20143 NUCLEAR PLATE CAMERAS FOR THE MEASUREMENT OF PROTON ENERGIES EMITTED FROM A OROIDAL DISCHARGE IN DEUTERIUM.

/.M.Jones, A.C.L.Barnard, K.M.Young, E.D.Taylor, D.G.Waters nd H.B.Mundy.
Iuclear Instrum. and Methods, Vol. 5, No. 5, 327-31 (Nov., 1959).

Two types used in Sceptre are discussed. One of these records nergies of protons emitted normal to the discharge axis, while the ther records protons emitted at about 45° or 135° to the direction f positive gas current along the axis. A later model of the second ype which records at both angles simultaneously, is also described. The size of slot in the wall of the discharge vessel necessitates hat the second type of camera should be very small, and should be laced close to the wall. Measures to prevent damage to the ıuclear plate by shock waves or overheating are given. The energy esolution of the cameras was also found using a monoenergetic eam of protons from the A.E.I. electrostatic generator.

Neutrons

539.12 : 539.14

20144 A HISTORY OF NEUTRONS AND NUCLEI. I. N.Feather.

Contemporary Physics, Vol. 1, No. 3, 191-203 (Feb., 1960).

539.12 : 539.14

20145 A HISTORY OF NEUTRONS AND NUCLEI. II. N.Feather.

Contemporary Physics, Vol. 1, No. 4, 257-66 (April, 1960).

539.12

20146 FORM-FACTOR OF THE NEUTRON FROM DEUTERON ELECTRO-DISINTEGRATION. S.K.Bose.

Nuovo Cimento, Vol. 17, No. 5, 767-74 (Sept. 1, 1960).

An extrapolation method is suggested to determine the magnetic form-factor of the neutron from deuteron electrodisintegration.

539.12

20147 EXPERIMENTAL STUDY OF THE MAGNETIC STRUCTURE OF THE NEUTRON.

J.I.Friedman, H.W.Kendall and P.A.M.Gram.
Phys. Rev., Vol. 120, No. 3, 992-9 (Nov. 1, 1960).

A measurement of the ratio of the magnetic form of the neutron to that of the proton was carried out by comparing large- and small-angle elastic electron—deuteron scattering at constant four-momentum transfers. The experimental results for the average value of the ratio in the range of momentum transfers from $1.6f^{-1}$ to $2.25f^{-1}$ is $F/_{2n}/F_p$ =(0.91 ± 0.05) ±0.07; the first error is a standard deviation arising from experimental uncertainties, and the second from theoretical uncertainties in the analysis. Measurements of the ratio of the nucleon isotopic scalar form factors have also been obtained from this experiment. The average value of $F_2{}^S/F_1{}^S$ for the same range of momentum transfers has been found to be (+0.06 ± 0.09) ±0.13. The small-angle scattering data were used to determine the charge form factor of the deuteron in the range of momentum transfers from $0.98f^{-1}$ to $2.8f^{-1}$. The results are consistent with a repulsive-core model of the deuteron.

539.12

20148 ON THE RATE OF CONVERGENCE OF THE SPHERICAL HARMONICS METHOD. (FOR THE PLANE CASE, ISOTROPIC SCATTERING). B.Davison.

Canad. J. Phys., Vol. 38, No. 11, 1526-45 (Nov., 1960).

The rate of convergence of the spherical harmonics method in neutron transport theory, for the plane case with isotropic scattering, is investigated, for an arbitrary number of layers of different materials, and both in the one-group and in the multi-group theory. The attention is centred upon the cases when there is no external supply of neutrons, so that one deals with an eigenvalue problem. The error in the eigenvalue due to the truncation of the spherical harmonics expansion is found to vary essentially as $O(1/N^2)$, where N is the order of the highest harmonics retained. The proof of this result consists of two parts. First, it is shown that the use of the spherical harmonics method, under the conditions stated, is strictly equivalent to making a certain approximation in the kernel of the integral equation for the flux; and then the error due to this approximation is assessed.

539.12

20149 POLYNOMIAL APPROXIMATION IN NEUTRON TRANSPORT THEORY. J.Mika and R.Zelazny.

Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 8, No. 1, 59-62 (1960).

The problem of using general orthogonal polynomials for the solution of a one-velocity Boltzmann equation is formulated. General considerations concerning the use of Jacobi and Gegenbauer polynomials are presented and the determination of an arbitrary parameter in Gegenbauer's case is given.

539.12

20150 ON THE OPTIMUM DIMENSIONS OF COLLIMATORS FOR NEUTRON DIFFRACTION. P.Szabó.

Nuclear Instrum. and Methods, Vol. 5, No. 3, 184-8 (Sept., 1959).

A calculation method is shown for determining the optimum dimensions of primary collimators of given collimating power for neutron diffractometers and crystal spectrometers. Exact expressions of closed form consisting of elementary functions are given for the calculation of transmitted intensity. Since the numerical evaluation of these expressions is rather lengthy and laborious, approximate formulae are also derived, and it is shown that in cases of practical interest the use of these latter and more convenient ones is quite sufficient.

539.12

20151 A USEFUL APPROXIMATION IN THE THEORY OF RESONANCE ABSORPTION. A.Keane and M.H.McKay.

Austral. J. appl. Sci., Vol. 11, No. 3, 321-8 (Sept., 1960).

An approximation introduced by Gurevich and Pomeranchouk (1955) is investigated and shown to be a useful means of supplementing tables presented recently by Cook and Elliott (Abstr. 13216 of 1960).

539.12

20152 STOCHASTIC STUDY OF THE HISTORY OF NEUTRONS IN A MODERATOR. G.Louchard.

ull. Acad. Roy. Belgique Cl. Sci., Vol. 46, No. 4, 233-49 (1960). French.

The history of neutrons in a moderator is treated as a sto-
astic process. The general equations for the corresponding
arkhoff problem are set up and solved by a generating function
chnique. Analytic results are given for some special cases and
hers are promised for a later paper. H.N.V.Temperley

539.12

20153 THE MEASUREMENT OF THE TOTAL CROSS-SECTION OF SOLID NEON AND ARGON FOR SLOW NEUTRONS.

.T.Springer and W.Wiedemann.

. Naturforsch., Vol. 15a, No. 9, 828-30 (Sept., 1960). In German.

Describes measurements of the total cross-section of solid
eon at 20° K and solid argon at 20° K and 77° K for monoenergetic
eutrons between 3×10^{-4} eV and 2.6×10^{-3} eV by the transmission
echnique. Extrapolation of the results gives the absorption cross-
ection at 0.025 eV for neon as $\cong 0.038 \pm 0.007$ barns and for argon
s 0.61 ± 0.03 barns. R.H.Thomas

539.12

20154 THE PRODUCTION OF "SUPERCOLD" POLARIZED NEUTRONS. G.M.Drabkin and R.A.Zhitnikov.

h. eksper. teor. Fiz., Vol. 38, No. 3, 1013-14 (March, 1960). In
ussian.

A method is described for increasing the yield of neutrons of
ow kinetic temperatures. The neutrons are slowed down by being
assed through a series of homogeneous magnetic fields each with
superimposed perpendicular oscillating component which flips
he neutron's spin. Useful yields at a temperature of 10^{-5}°K are
ossible. J.S.Dowker

539.12

20155 LOW SCATTER HIGH CURRENT GAS TARGET FOR D—D NEUTRONS. A.C.B.Richardson.

ev. sci. Instrum., Vol. 31, No. 11, 1202-3 (Nov., 1960).

A target for the production of neutrons by the D(d,n) He^3
eaction is described. The target gas is circulated to cool the
oils used as entrance and exit windows for the incident deuteron
eam. Low mass construction is employed to minimize the scat-
ering of neutrons.

539.12

20156 A MECHANICAL SELECTOR FOR SLOW NEUTRONS. G.Gobert and B.Jacrot.

. Phys. Radium, Vol. 19, Suppl. No. 4, 51A-59A (April, 1958). In
rench.

It is constructed of two rotors (diameter 1m) 1 m apart. The
otation speed is 6 000 r.p.m. The width of the line obtained is —
n the best conditions — 50 μs. Mechanical problems encountered
uring the construction are analysed.

539.12

20157 A FAST NEUTRON TIME-OF-FLIGHT SPECTROMETER. J.B.Garg.

uclear Instrum. and Methods, Vol. 6, No. 1, 72-82 (Dec., 1959).

A time-of-flight spectrometer for the measurement of neutron
nergies in the range 0.5 to 15 MeV has been constructed. The full
ime resolution width of the prompt $\gamma-\gamma$ coincidence curve from a
ource of Co^{60} is 6.5×10^{-10} sec. This time resolution corresponds
o an energy resolution of about 1% for neutrons of energy 1 MeV,
or a flight path of 1.5 m, and it thus enables the study of closely-
paced levels in nuclei. The limitations on the time resolution
btained are discussed and ways of further improvement are
uggested.

539.12

20158 A DIRECTIONAL SCINTILLATION COUNTER FOR NEUTRONS. R.F.Stetson and S.Berko.

uclear Instrum. and Methods, Vol. 6, No. 1, 94-5 (Dec., 1959).

A description of several models constructed of plastic filaments
s given. Ratios as high as 1000 : 1 have been obtained for the
ounting rate with filamental axis parallel to the neutron direction
o the counting rate with filamental axis perpendicular to the
eutron direction.

539

20159 SCINTILLATOR FOR THERMAL NEUTRONS USING Li^6F AND ZnS(Ag). R.Stedman.

Rev. sci. Instrum., Vol. 31, No. 10, 1156 (Oct., 1960).

539

20160 IMPROVED "TWIN" SCINTILLATION FAST NEUTRO DETECTOR. I.B.Berlman, R.Grismore and B.G.Oltm

Rev. sci. Instrum., Vol. 31, No. 11, 1198-1200 (Nov., 1960).

Improvements are presented in the use of the "twin" scintil-
lation detector in an earlier paper (Abstr. 661 of 1957). Conditior
are specified under which the fluorescence yield is maximized an
the proton to electron ratio equalized in both solutions. For a
neutron energy of 2.19 MeV the instrumental line width is 23%. T
estimated lower limit of its potential range is $\frac{1}{4}$ to $\frac{1}{3}$ MeV. Other
improvements in sensitivity have permitted the measurement of
background neutron fluxes of the order of those produced by cosm
rays.

539.1

20161 THE STILBENE SCINTILLATION CRYSTAL AS A SPECTROMETER FOR CONTINUOUS FAST-NEUTRO SPECTRA. H.W.Broek and C.E.Anderson.

Rev. sci. Instrum., Vol. 31, No. 10, 1063-9 (Oct., 1960).

A method is described for measuring neutron spectra in the
energy range 1 to 10 MeV. The pulse-height spectrum of scintil-
lations produced in a stilbene crystal by recoil protons originatin
in the crystal is analysed to yield the incident neutron energy
distribution. Insensitivity to gamma rays and electrons is achieve
by utilizing differences in the pulse shapes of light pulses produce
by electrons and protons. This spectrometer is useful for both
group and continuous spectra and has been tested by measurement
of the spectra from a Pu—Be neutron source and from the spontan
ous fission of Cf^{252}. Both measurements are consistent with previ
data. The Pu—Be data definitely confirm a peak at 9.7 MeV that
was suggested by previous data.

539.

20162 TECHNIQUE FOR USING THE Np^{237} FISSION REACTIC AS A DETECTOR FOR FAST NEUTRONS IN A REACT

D.Binder.

Rev. sci. Instrum., Vol. 31, No. 8, 902-3 (Aug., 1960).

This detector consists of a film of Np^{237} on thick nickel foil,
this is covered by a 0.3 mg/cm² of Al foil to trap Np^{238} recoils,
while allowing 90% of the fission products to pass through into a
7 mg/cm² aluminium catcher. By comparing the activity of this
detector with that of Pu^{239} after thermal neutron irradiation, it was
shown that this technique gives sufficient masking of the competing
Np^{238} activity. D.H.Lo

539.1

20163 COUNTER TELESCOPE MEASUREMENT OF NEUTRON FLUX.

S.J.Bame, Jr, E.Haddad, J.E.Perry, Jr, R.K.Smith and B.Swartz.

Rev. sci. Instrum., Vol. 31, No. 8, 911-13 (Aug., 1960).

Efficiency factors for a neutron telescope consisting of an
hydrogenous radiator and exit aperture have been recalculated for
various geometries and neutron energies. The results differ from
these quoted previously by up to 4.7% in an extreme case, but are
generally within 2%. A.E.I. Research Laborator

Mesons

539.12

20164 A NOTE ON A POSSIBLE CLASSIFICATION OF STRANGENESS-2 MESONS.

G.Bialkowski and A.Jurewicz.

Nuovo Cimento, Vol. 16, No. 4, 756-9 (May 16, 1960).

Discusses how such mesons might be included in various elementary particle classification schemes. R.J.N.Phillips

539.1

20165 THE MULTIPLE SCATTERING OF PARTICLES OF OPPOSITE CHARGE. I.S.Hughes and D.Sinclair.

Phil. Mag. (Eighth Ser.), Vol. 4, 1013-16 (Sept., 1959).

Earlier investigations by a number of workers have revealed
an apparent difference in the multiple scattering of positively and
negatively charged particles which is much greater than that

dicted by theory. Experiments have now been carried out in ch the existence of such a difference was investigated for the ltiple scattering of positive and negative μ mesons, π mesons electrons in nuclear emulsions. No significant difference was nd.

539.12

0166 ON THE RADIATIVE CORRECTIONS TO THE SCATTERING OF MESONS IN AN EXTERNAL ECTROMAGNETIC FIELD. A.K.Bhatia and J.Sucher.

ogr. theor. Phys., Vol. 20, No. 3, 397-8 (Sept., 1958).

The results for the radiative corrections for scattering of spin o particles, carried out by Kinoshita and Nambu in the Duffin-mmer formalism (Abstr. 5093 of 1951) have been obtained more nply by the Klein—Gordon formalism. It is pointed out that there a factor 2 error in one term of the previous work.

R.F.Peierls

539.12

20167 PROBABILITY OF MESON CAPTURE IN VARIOUS MESO-ATOMIC LEVELS. S.S.Gershtein.

eksper. teor. Fiz., Vol. 39, No. 4(10), 1170-2 (1960). In Russian.

A simple model is discussed, in which,when a meson reaches a stance smaller than R of order 0.64 $\hbar^2/me^2$, an electron is adiaba- cally ionized. Capture is most likely for $n = n_0$ of order $(\mu/m)^{1/2}$ d l of order $(\mu/m)^{1/3}$.

D.W.L.Sprung

539.12

20168 A POSSIBLE EXAMPLE OF THE MUON RADIATIVE DECAY WITH INTERNAL CONVERSION OF THE γ-RAY.

Mayes.

Phil. Mag. (Eighth Ser.), Vol. 5, 297-8 (March, 1960).

An event is described in which a μ-meson at rest in a photographic emulsion decayed into three relativistic electrons (a pair and a positron). From the scattering measurements the energies of the pair and the positron were found to be 40 ± 16 and 18 ± 5 MeV respectively. The angles between the tracks were $\psi(e_1e_2) \cong 5°$, $\psi(e_1e_3) \cong 60°$ and $\psi(e_2e_3) \cong 58°$. Various possible interpretations of the event are discussed but from probability considerations it is concluded that it represents an example of μ-meson radiative decay.

C.F.Barnaby

539.12

20169 MEASUREMENT OF THE GAMMA-RAY SPECTRUM FROM RADIATIVE MUON DECAY.

C.O.Kim, W.J.Kernan and C.M.York.

Phys. Rev., Vol. 120, No. 3, 983-7 (Nov. 1, 1960).

The energy spectrum of the gamma rays emitted by inner bremsstrahlung in the muon decay process, $\mu^+ \rightarrow e^+ + \nu + \bar{\nu} + \gamma$, was measured by means of a large sodium iodide crystal. Only those gamma-rays which were time-coincident with the decay electrons were recorded. These decay electrons were detected in a scintillation counter telescope adjoining the crystal counter. The counter geometry permitted detection of events with angles between the electron and gamma ray in the range from 0° to 26°. The muons were obtained by stopping a positive pion beam in a block of material. By measuring the gamma-ray spectra from muons originating first in carbon and then aluminium, a correction could be made for bremsstrahlung externally produced by the decay electrons. The measured spectrum is in agreement with that predicted by the theory with an average ratio of 1.02 ± 0.10.

539.12

20170 ON THE RADIATIVE MUON DECAY.

S.Sawada and M.Yonezawa.

Progr. theor. Phys., Vol. 22, No. 2, 309-10 (Aug., 1959).

It is suggested that most of the events observed by Davis et al. (Abstr. No. 11379 of 1959) and attributed to the decay $\mu \rightarrow e + \gamma$ may in fact be $\mu \rightarrow e + \nu + \bar{\nu} + \gamma$, thus making their estimate of the branching ratio $\mu \rightarrow e + \gamma / \mu \rightarrow e + \nu + \bar{\nu}$ too large.

J.E.Paton

539.12 : 539.18

DECAY OF BOUND MUONS. See Abstr. 20565

539.12

20171 THE INTERACTION RATES OF STOPPED NEGATIVE MUONS IN VARIOUS ELEMENTS.

W.B.Gilboy and R.M.Tennent.

Phil. Mag. (Eighth Ser.), Vol. 4, 1055-62 (Sept., 1959).

The lifetimes of negative muons brought to rest in a series elements were measured. The mean lifetimes were found to be: Cr, (268 ± 16) n sec; Mn, (251 ± 14) n sec; Fe, (205 ± 14) n sec; Co, (196 ± 11) n sec; Ni, (160 ± 10) n sec; Cu, (168 ± 7) n sec; Zn, (151 ± 13) n sec. Using different assumptions, the various interaction rates were calculated and compared with the theories Primakoff and Tolhoek and Luyten. Measurements of the time delays in Geiger counter discharges and photomultiplier after-pu are described.

53

20172 MEASUREMENT OF THE MUON MASS BY CRITICA MESIC X-RAY ABSORPTION. I. SCINTILLATION SPECTROMETRY. J.Lathrop, R.A.Lundy, V.L.Telegdi, R.Winst and D.D.Yovanovitch.

Nuovo Cimento, Vol. 17, No. 1, 109-13 (July 1, 1960).

The method consists of determining the transition energy E_i of the 3D → 2P transition in μ-mesic phosphorus, and hence the μ-meson mass, using lead absorbers and making use of the fact that E_{if} lies very close to the Pb K-edge. The μ-mesons were fi slowed down and then stopped in a 2 g/cm² P target. Various thi nesses of Pb absorber were placed between this target and a NaI spectrometer. The best fit value for the energy of the transition 87.992 keV corresponding to $m_\mu = (206.74 {}^{+0.03}_{-0.04})\ m_e$. A careful d cussion is given of the derivation of this result from the measure ments.

J.D.Dow

539

20173 MEASUREMENT OF THE MUON MASS BY CRITICA MESIC X-RAY ABSORPTION. II. PROPORTIONAL COUNTER SPECTROMETRY.

J.Lathrop, R.A.Lundy, S.Penman, V.L.Telegdi, R.Winston, D.D.Yovanovitch and A.J.Bearden.

Nuovo Cimento, Vol. 17, No. 1, 114-18 (July 1, 1960).

The principle of the method is the same as in Pt I, but a xen filled proportional counter was used instead of a NaI(Tl) crystal, giving three to four times better resolution. A description of the counter is given. The result obtained is $m_\mu = (206.76 {}^{+0.02}_{-0.03})\ m_e$ i good agreement with Pt I and with the prediction of (206.77 ± 0.013) from quantum electrodynamics.

J.D.Dow

53

20174 ON THE μ—e MASS DIFFERENCE.

V.Wataghin.

Nuovo Cimento, Vol. 17, No. 4, 611-13 (Aug. 16, 1960).

It is assumed, without any attempt at justification, that, in calculating the contribution of the weak coupling intermediate bo to the self-mass of the electron and the muon, the unrenormalize coupling constants should be used. Since these are not observabl in weak interactions they can be arbitrarily assigned, and values are chosen which fit the muon—electron mass difference for a g mass of the intermediate boson.

E.J.Squi

53

20175 ON THE μ-MESON MASS.

H.Kita and E.Predazzi.

Nuovo Cimento, Vol. 17, No. 6, 908-18 (Sept. 16, 1960).

A possibility of explaining the anomalously large mass of th μ-meson by taking account of the high singularity of the weak Fe interaction is discussed. It is shown that a single spinor field interacting weakly with a two-component neutrino field can descr the electron and the μ-meson as its ground and excited states re pectively by solving an eigenvalue problem which comes from th negativeness of the self-energy of $\overset{(W)}{\psi}$ due to the adopted weak Fe interaction and by using an invariant cut-off method. The order magnitude of the cut-off parameter is about the inverse of the we coupling constant l_W ($l_W = 6.85 \times 10^{-17}$ cm). The possible import of the high singularity of the Fermi interaction is emphasized. problem of the μ-meson decay is also discussed.

539

20176 A MEASUREMENT OF THE SPIRALITY OF THE μ-MESON.

A.I.Alikhanov, Yu.V.Galaktionov, Yu.V.Gorodkov, G.P.Eliseev a V.A.Lyubimov.

Zh. eksper. teor. Fiz., Vol. 38, No. 6, 1918-20 (June, 1960). In Russian.

A counter experiment for investigating the scattering of pol rized μ-mesons by polarized electrons in magnetized iron is de cribed. Agreement with the V—A weak interaction theory prediction is possible. See Abstr. 13010 of 1960. J.S.Dowker

539.12

20177 SEARCH FOR THE "ANOMALOUS" SCATTERING OF MU-MESONS (ON THE APPARATUS USING A DELAYED COINCIDENCE METHOD). T.Kitamura.

J. Phys. Soc. Japan, Vol. 14, No. 12, 1654-63 (Dec., 1959).

Experimental results on the anomalous scattering of μ-mesons so far obtained are discussed, and it is concluded that previous apparatus has two principal deficiencies in reaching a definite conclusion: uncertainties in determining the identity and momenta of μ-mesons. Hence, it was planned to complete the experiment by using an arrangement of Wilson cloud chamber and G—M counters which is capable of selecting only μ-mesons, their momenta being determined with a thick absorber within a narrow range of $(1^{+0.15}_{-0.20})$ GeV/c, and a delayed coincidence method to separate μ-mesons from the other particles. The possibility of triggering this arrangement with other particles than μ-mesons is estimated and found to be quite negligible.

539.12

20178 $\pi^{\pm}$ TRACKS IN A FILAMENT SCINTILLATION CHAMBER.

G.T.Reynolds, R.A.Swanson and D.B.Scarl.
Rev. sci. Instrum., Vol. 31, No. 9, 1011-13 (Sept., 1960).

539.12

20179 ON THE DECAY RATE OF THE CHARGED PION.

J.Bernstein, S.Fubini, M.Gell-Mann and W.Thirring.
Nuovo Cimento, Vol. 17, No. 5, 757-66 (Sept. 1, 1960).

The Goldberger—Treiman relation between the pion decay amplitude and the axial vector coupling constant in β-decay is shown to be plausible if the divergence of the axial vector current is a highly non-singular operator (i.e., one that emphasizes low frequencies). Such a situation is probably realized, for example in a renormalizable theory for which this operator is proportional to the conventional pion field. Some other possible consequences of the low-frequency character of the operator are mentioned.

539.12

20180 ASYMMETRY OF $\pi^+ - \mu^+ - e^+$-DECAY IN A MAGNETIC FIELD. A.O.Vaisenberg and V.A.Smirnitskii.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 242-8 (Aug., 1959). In Russian.

The dependence of the coefficient of spatial asymmetry of this decay on magnetic field strength was measured in the range from 0 to 17 kOe. It is shown that this effect can be explained by the Paschen—Back effect for muonium under the assumption of additional depolarization due to charge exchange at the end of the μ^+-meson range or to exchange collisions after stopping. For the NIKFI-R emulsion, the minimal value of the asymmetry coefficient is -0.09 ± 0.01 (without the field). The maximal value is -0.29 ± 0.01 (strong fields). The 10% difference between the value of the coefficient -0.29 ± 0.01 (strong fields). The 10% difference between the value of the coefficient -0.29 ± 0.01 and the value -0.33 predicted by the V—A theory greatly exceeds the experimental errors. No decays involving three electrons were detected among the 340 000 $\pi^+ - \mu - e$ decays examined.

539.12

20181 ON THE POSSIBLE ROLE OF $\pi^{0'}$-MESON IN DECAY PROCESS. S.Sawada and M.Yonezawa.

Progr. theor. Phys., Vol. 22, No. 5, 610-16 (Nov., 1959).

The existence of a heavy neutral pseudoscalar meson with isotopic spin zero ($\pi^{0'}$) is assumed and its effects on the K-meson decay are discussed. In particular the K_e^+ experimental data are re-examined by assuming the $K_{e_3}^+$ ($K^+ \to \pi^0 + e^+ + \nu$) and $K_{e_3}^+$($K^+ \to \pi^0 + e^+ + \nu$) modes. Analysis shows that the V—A Fermi interaction can give an electron energy spectrum consistent with present experiments.

539.12

20182 A LOWER LIMIT ON THE π^0 LIFETIME.

S.C.Frautschi.
Progr. theor. Phys., Vol. 22, No. 4, 544-8 (Oct., 1959).

The assumption is made that the $\gamma + p \to \gamma + p$ scattering amplitude can be analytically continued to the pole arising from exchange of a π^0 between p and γ. Experiment limits the possible size of the residue at the pole, thus providing a lower limit $\tau \gtrsim 6 \times 10^{-19}$ sec on the π^0 lifetime.

539.1

20183 $\pi^0 - \pi^-$ MASS DIFFERENCE AS DETERMINED FROM DOUBLE DALITZ PAIRS. N.P.Samios.

Nuovo Cimento, Vol. 18, No. 1, 154-9 (Oct. 1, 1960).

The mass difference was determined by measuring the mome of the two internally converted electron—positron pairs from π^0-decay. A total of 119 events gave a value $m_{\pi^-} - m_{\pi^0}$ = (4.69 ± 0.0 MeV.

539.1

20184 THE COUPLING CONSTANT OF THE MESON—NUCLEON INTERACTION. M.Cini and S.Fubini.

Nuovo Cimento Suppl., Vol. 6, No. 1, 401-2 (1957). In Italian.

Summary of a conference review talk on the significance of the π—N coupling constant and how it may be measured. R.J.N.Phillip

539.1

20185 THE INTERACTION OF π^--MESONS WITH COMPLEX NUCLEI IN THE ENERGY RANGE (100-800 MeV. I. THE INTERACTION LENGTHS AND ELASTIC SCATTERING OF 88 MeV π^--MESONS IN G5 EMULSION.

J.E.Allen, A.J.Apostolakis, Y.J.Lee, J.V.Major and E.P.Ferreira.
Phil. Mag(Eighth Ser.), Vol. 4, 858-67 (July, 1959).

A block of emulsion was exposed to the 96 MeV π^--meson beam of the Liverpool synchrotron and 92.5 m of track were scann in the region where the mean energy is 88 MeV. After correction for beam contamination, the interaction lengths for the production of inelastic events and for elastic scatters with projected angle of scatter $\geq 8^0$ are (20.4 ± 1.1) cm and (32.3 ± 2.1) cm. respectively. The geometrical interaction length is 29.3 cm. With the optical model of the nucleus, the absorption coefficient is found to be $K = (4.0^{+2.5}_{-0.75})\ 10^{12}\ \mathrm{cm}^{-1}$, and the change in wave number is given by $k_1 = -(1.86 \pm 0.20) 10^{12}\ \mathrm{cm}^{-1}$. This absorption coefficient corresponds to a mean free path in nuclear matter $\lambda_n = (2.5^{+0.9}_{-0.7})\ 10^{-13}$ cm to an imaginary component of potential $V_i = -(32^{+20}_{-8})$ MeV, and wit the value of the change in wave number to a real potential $V_r = -28 \pm 3$ MeV.

539.

20186 THE ANALYSIS OF 4.5 BeV NEGATIVE PION INTERACTIONS IN NUCLEAR EMULSION.

H.H.Aly, J.G.M.Duthie and C.M.Fisher.
Phil. Mag. (Eighth Ser.), Vol. 4, 993-1005 (Sept., 1959).

Two hundred nuclear interactions produced in Ilford G5 nuclea emulsion by 4.5 BeV π^--mesons were analysed. The transverse momentum of those secondary shower particles identified as pions has an average value over all angles of 290 ± 50 MeV/c. The mea multiplicity of shower particles from the interactions is 2.0 ± 0.1 and is independent of the number of heavily ionizing prongs N_h. About 90% of the shower particles were estimated to be pions. The angular distribution in the C-system is anisotropic with a mean value for $|\cos\theta^*|$ of 0.58 ± 0.03. Assuming that secondary pions are emitted symmetrically backwards and forwards from a single collision system, the observed angular distribution of shower particles is used to determine the effective mass of the collision partner. It is found to be $1.40^{+0.47}_{-0.27}$ proton mass units. If the total distribution is divided into groups with respect to N_h it is found that events having $N_h \leq 7$ yield a value of $0.77^{+0.36}_{-0.19}$ proton mass units whilst those having $N_h > 7$ yield $2.3^{+0.9}_{-0.4}$ proton mass units.

539.1

20187 INTERNAL PAIRS FOLLOWING π^- CAPTURE IN HYDROGEN.

M.Derrick, J.G.Fetkovich, T.H.Fields and J.Deahl.
Phys. Rev., Vol. 120, No. 3, 1022-7 (Nov. 1, 1960).

Internal electron pairs from the two reactions

$$(1)\ \pi^- + p \to n + \pi^0 \to n + \gamma + e^+ + e^- \text{ and } (2)\ \pi^- + p \to n + e^+ + e^-$$

were studied in a hydrogen bubble chamber. 2184 cases were seen. A geometrical cutoff selected 1523 of these as suitable for momentum measurement. By an analysis of the momentum spectru the Panofsky ratio was measured to be 1.51 ± 0.10. The total intensity, momentum partition within the pairs, and distribution in virtual photon mass are in essential agreement with the theoretical predictions of Kroll and Wada as recently extended by Joseph.

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188

PROPERTIES OF THE PION—PION INTERACTION DERIVED FROM THE ANALYSIS OF PION—NUCLEON TERINGS.

I.Sato, A.Takahashi and Y.Ueda.

r. theor. Phys., Vol. 22, No. 5, 617-37 (Nov., 1959).

The properties of the pion—pion interaction are discussed by se of dispersion relation techniques. New dispersion relations ion—nucleon scattering are obtained by applying the reduction ula to the initial pion and final nucleon operators. In each of dispersion relations the absorptive part is divided into two , one of which is written as an integral of the pion—pion scat- ig amplitude multiplied by a certain matrix element similar to ion—nucleon scattering amplitude, while the other is written rms of the phase shifts for pion—nucleon scattering. There- , if the pion—pion scattering amplitude is expressed in terms known parameters, such as scattering lengths and effective es, their values can be determined by the use of these disper- relations. Thus one can obtain some knowledge about the sign the strength of the pion—pion interaction. In this way it is luded that: (a) in the isotopic spin state I = 0 of the pion—pion em, the pion—pion interaction is attractive and its strength is that the scattering length for the pion—pion scattering is of same order of magnitude as that of the pion Compton wave th; (b) in the isotopic spin state I = 1 of the pion—pion system interaction is also attractive and is of the strength at least parable to that of the pion—nucleon interaction in the (3,3) state.

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20189

AN INTERPRETATION OF THE PEAK IN THE CROSS-SECTION OF $\pi^- + p \rightarrow K^0 + \Lambda$.

Y.Nogami and R.Sugano.

ogr. theor. Phys., Vol. 22, No. 6, 907-9 (Dec., 1959).

The cross-section peak at a pion bombarding energy of about eV is interpreted on a "compound" model in which the T = $\frac{1}{2}$ p isobar has a certain probability of decaying into any of the ilable channels.

J.E.Paton

539.12

20190

A POSSIBLE SYMMETRY PROPERTY OF THE π—K SYSTEM.

Chzhou Guan-Chzhao [Chou Kuang-Chao].

h. eksper. teor. Fiz., Vol. 38, No. 3, 1015-16 (March, 1960). Russian.

The consequences are discussed of assuming a Hamiltonian r the π—K system with no derivative interactions. The separate variance of this Hamiltonian under independent rotations of the -and K fields in their isospin spaces gives rise to selection rules r the π—K scattering amplitudes. It is pointed out how the study K—N interactions might give information about their validity.

R.F.Peierls

539.12

20191

RESONANCE MODEL FOR THE $\pi + N \rightarrow \pi + \pi + N$ REACTION AT 300-450 MeV MESON ENERGIES.

V.Anisovich.

h. eksper. teor. Fiz., Vol. 39, No. 1(7), 97-104 (July, 1960). In ussian.

It is assumed that the dependence of the matrix element on nergy is only due to resonance interaction between the nucleon and one of the mesons in the final state ($^3/_2$, $^3/_2$) and that these esonantly interacting particles carry off most of the energy of he system. Expressions containing six parameters for the reac- ion cross-sections are given for these conditions. It is shown that he available experimental data agree with the results of the given model.

539.12

20192

π—π CHARGE EXCHANGE CROSS SECTION FROM ANALYSIS OF $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ AT 290 MeV.

Yu.A.Batusov, S.A.Bunyatov, V.M.Sidorov and V.A.Yarba.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 506-9 (Aug., 1960). In Russian.

The cross-section determined from 200 events in emulsion is 4^{+6}_{-4} mb. The theory used assumes inter alia that P phases are small which may not be correct at this energy, although the data are consistent with the (linear) predicted dependence of dσ on final momenta.

D.W.L.Sprung

539.12

20193

THE REAL PART OF THE ELASTIC SCATTERING AMPLITUDE AT HIGH ENERGIES.

V.S.Barashenkov and Syan' Din Chan [Hsien Ting Ch'ang].

Dokl. Akad. Nauk SSSR, Vol. 134, No. 1, 65-7 (Sept. 1, 1960). In Russian.

Using the Goldberger "sum rule" and an empirical fit to the pion—nucleon cross-section at high energies an expression for the real part of the elastic scattering amplitude is found. The restrictions imposed on this by the energy dependence of the elastic cross-section lead to the empirical result that it equals $-0.22\,(E)^{-1/2}$f., in the π—N c.m. system. E is the laboratory pion energy in GeV.

J.S.Dowker

539.12

20194

SINGLE-VIRTUAL-BOSON-EXCHANGE INTERACTION IN HIGH-ENERGY COLLISIONS.

F.Salzman and G.Salzman.

Phys. Rev. Letters, Vol. 5, No. 8, 377-9 (Oct. 15, 1960).

Recent experimental evidence points towards the importance of a long range interaction, i.e. $\sim m_\pi^{-1}$, in high energy collisions of π-mesons with nucleons and of nucleons with nucleons. Assuming a model in which two incident particles collide by exchanging a single virtual π-meson, it is shown that if these graphs dominate in collisions in which the square of the virtual pion's four-momentum is very small, then a simple field-theoretical model of such collisions results. From conservation of four-momentum at each of the two vertices an expression is obtained for the square of the four-momentum Δ^2, of the exchanged boson. In the case of proton—proton collisions it is found that Δ^2 may be small in collisions in which a number of additional particles are produced or for small angles of scattering. It is shown that the main field-theoretical simplification results from the fact that for small values of Δ^2, the virtual boson behaves kinematically as an incoming "almost real" particle. An expression is given for the differential cross-section which is expected to be valid for all processes in which large impact-parameter collisions are dominant.

J.H.Gunn

539.12

20195

ELASTIC SCATTERING OF 5 BeV π^- MESONS ON HYDROGEN.

R.G.Thomas, Jr.

Phys. Rev., Vol. 120, No. 3, 1015-20 (Nov. 1, 1960).

The elastic scattering of 5 BeV π^- on hydrogen was observed in a large propane bubble chamber. It is shown that ~7 ± 3% of the events called elastic are probably background. The observed angular distribution is strongly peaked forward. This fact suggests that diffraction scattering is the dominant process at this energy. The theoretical analysis of the distribution is in terms of the optical model. It is shown that the proton acts like a partially opaque sphere of radius 1.04×10^{-13} cm ± 5%. The total elastic cross-section is found to be 5.6 ? 0.5 mb. From the extrapolated value of $d\sigma(0)/d\Omega = 29.8$ mb/sr ± 10% in the centre-of-mass system, a value of 29.1 ± 2.9 mb was calculated for the total hydrogen cross-section. The opacity of the sphere is thus 0.69 ± 0.05.

539.12

20196

CHARGE-EXCHANGE SCATTERING OF 240-330 MeV π^--MESONS ON HYDROGEN.

V.G.Zinov and S.M.Korenchenko.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1399-406 (1960). In Russian.

Reports the results of measurement of the differential cross-sections for charge-exchange scattering of 240, 270, 307 and 333 MeV π^--mesons on hydrogen. See also following abstract.

539.12

20197

PHASE-SHIFT ANALYSIS OF SCATTERING OF 240-330 MeV π-MESONS ON HYDROGEN.

V.G.Zinov, S.M.Korenchenko, N.I.Polumordvinova and G.N.Tentyukova

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1407-18 (1960). In Russian.

Reports the results of a phase-shift analysis of the experimental data (see preceding abstract) on scattering of π-mesons on nucleons in the energy range from 240 to 330 MeV. Information on phase shifts for the interaction of π-mesons in states with a spin T = $\frac{1}{2}$ was obtained.

539.12

20198

PION—NUCLEON SCATTERING IN THE MANDELSTAM REPRESENTATION.

S.C.Frautschi and J.D.Walecka.

Phys. Rev., Vol. 120, No. 4, 1486-1505 (Nov. 15, 1960).

Using the analytic properties of partial-wave scattering amplitudes, as derived from Mandelstam's representation (Abstr. 4941 of 1959; 1256 of 1960), the authors have studied the J = $\frac{3}{2}$, P state of the pion—nucleon system. The method used is covariant, it incorporates unitarity, and the effect of a possible pion—pion resonance is investigated. Using the "single nucleon term" and the low-energy scattering properties of the "crossed states", a resonance in the $J = \frac{3}{2}$, $T = \frac{3}{2}$ pion—nucleon state is obtained without the aid of a cutoff. Scattering in the $T = \frac{1}{2}$ state is also investigated. The pion—pion resonance appears to have only a very small effect in the $T = \frac{3}{2}$ state whereas in the $T = \frac{1}{2}$ state it increases the phase shift by a factor of 2. The resonance obtained in the $T = \frac{3}{2}$ state occurs at too low an energy. There are several factors which may account for this: the authors have not been able to include fully the contributions from crossed states, and have not systematically included inelastic scattering.

539.12

20199 PSEUDOSCALAR COUPLING AND S-WAVE PION—NUCLEON AND KAON—NUCLEON SCATTERING.

R.Sugano.

Progr. theor Phys., Vol. 22, No. 3, 381-95 (Sept., 1959).

Pion—nucleon s-wave scattering is investigated in the case of the Yukawa interaction of pseudoscalar coupling, making use of the Chew—Low formalism. It is shown that the s-wave amplitude of the π—N scattering is strongly damped compared with the perturbation-theory calculation. This is due to the fact that the second-order matrix elements are almost cancelled by some of the fourth-order ones which appear in the reduced Chew—Low equation as modified Born terms. Photopion production near the threshold energy is also discussed in a similar manner. Here a similar cancellation does not occur and the amplitudes for this process remain unchanged. The charge ratio of photopion production at the threshold energy is calculated, giving a value 2.27 which is larger than the experimental one 1.87 ± 0.13. In addition, low-energy K-nucleon and π—hyperon scattering are treated in a similar manner.

539.12

20200 EFFECT OF STRANGE PARTICLES ON THE S-WAVE PION—NUCLEON SCATTERING.

A.Komatsuzawa, Y.Nogami and R.Sugano.

Progr. theor. Phys., Vol. 22, No. 5, 638-42 (Nov., 1959).

The effect at low energies is examined qualitatively. It is shown that this effect is too small to play an essential role in the suppression of the isospin-even part of the phase shift, but is very important in the isospin-odd part.

539.12

20201 PERIPHERAL π-MESON— NUCLEON [INELASTIC] INTERACTION AT HIGH ENERGIES. I.M.Dremin.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 130-3 (July, 1960). In Russian.

The exchange of a virtual π-meson is taken into consideration. The cross-section of a process in which two mesons are produced is computed. The relations between the cross-sections of various channels of the process $\pi^- + p \rightarrow N + 3\pi$ are presented.

539.12

20202 PION—NUCLEON SCATTERING AT LOW ENERGIES. I. A.V.Efremov, V.A.Meshcheryakov and D.V.Shirkov.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 438-49 (Aug., 1960). In Russian.

Integral equations for πN-scattering are derived on basis of the Mandelstam representation. The kernels of the equations contain the lowest $\pi\pi$-scattering phases.

539.12 : 539.11

20203 THE PION—NUCLEON S-WAVE SCATTERING, THE STRUCTURE OF THE NUCLEON AND THE COMPOSITE MODEL OF BARYONS AND MESONS. Y.Ataka.

Progr. theor. Phys., Vol. 22, No. 3, 321-34 (Sept., 1959).

It seems impossible that pion—nucleon s-wave scattering can be explained in the frame of meson theory. It is suggested from experimental results that the static pion—nucleon potential with the appropriate isospin dependence has the possibility of explaining this phenomenon. The following characteristics of Fermi—Yang's composite model of pions are noticed: (a) Pions are bound states of one nucleon and one antinucleon. (b) An attractive short-range static potential exists between a nucleon and antinucleon, and a repulsive short-range static potential between a nucleon and nucleon. (c) The numbers of nucleons and antinucleons are independently conserved. Using this model, the author obtains the static potential between a pion and a nucleon. When the interaction type is vector, the static pion—nucleon potential with the charge dependence $\tau \cdot \omega$ is given. In this case, the pion—nucleon force in the state $I = \frac{1}{2}$ becomes attractive, bound states of two nucleons and one antinucleo may therefore be possible. This bound state of total isospin one-half and spin one-half is considered as the nucleon core. The possibility of understanding the extension and other mysterious properties of the nucleon core thus exists.

539.1

20204 S-WAVE INTERACTION IN π—N SYSTEMS AND DISPERSION RELATION. S.Minami.

Progr. theor. Phys., Vol. 22, No. 6, 901-3 (Dec., 1959).

A subtraction is made in the π—N forward—scattering dispersion relation that involves an integral over the sum of two cross-sections, the subtraction constant being obtained by considerations in the limiting case $\mu = \frac{1}{2}$, $\omega \rightarrow 0$. This makes possible a determination of the $T = \frac{1}{2}$ and $\frac{3}{2}$ S-wave phase shifts in good agreement with data. J.E.Pato

539.1

20205 TRIPLE SCATTERING OF 660 MeV PROTONS. II. ANGULAR DEPENDENCE OF DEPOLARIZATION.

Yu.P.Kumekin, M.G.Meshcheryakov, S.B.Nurushev and G.D.Stoletov.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1451-5 (1960). In Russian.

For Pt I, see Abstr. 12554 of 1959. The depolarization parameter was measured for a beam of 640 MeV protons scattered by protons through angles of 54, 72, 108 and 126° in the c.m.s. The normal polarization component of the proton beam changed only slightly in scattering through angles of 54, 72 and 90°. The sum and difference of the depolarization parameter for scattering angles symmetrical with respect to the 90° direction were interpreted in terms of the pp-scattering matrix amplitude.

539.12

20206 PION—PION INTERACTION AND THE ELECTROMAGNETIC STRUCTURE OF THE NUCLEON IN THE STATIC THEORY. E.V.Teodorovich.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 476-9 (Aug., 1960). In Russian.

An estimation of the quadratic mean radius of the π-meson charge distribution is made on basis of the relation between this radius and the $\pi\pi$-scattering resonance energy derived from the dispersion relations. The calculations of the quadratic radius of the nucleon charge distribution are performed within the framework of the Chew—Low—Wick static theory, by taking into account the electromagnetic structure of the meson. Good agreement with experimental data was obtained.

539.12

20207 CASCADE TIME OF π^- IN LIQUID HYDROGEN. T.H.Fields, G.B.Yodh, M.Derrick and J.G.Fetkovich.

Phys. Rev. Letters, Vol. 5, No. 2, 69-70 (July 15, 1960).

The time taken for negative pions to go from a velocity of 0.01 c to nuclear capture in liquid hydrogen was measured for pions stopping in a 15 cm hydrogen bubble chamber. This was determined by observing the relative proportions of decays and captures of the pions, using the kinematics of the π—μ—e decay to determine the velocity of a pion at the instant of decay. Out of 80 000 pions coming to rest in the central region of the chamber, two were found to decay at a velocity of less than 0.01 c. Taking into account the lifetime of the π-meson this gives a result of $(1.2^{+1.2}_{-0.5}) \times 10^{-12}$ sec for the time taken to be captured. The cascade time observed is about two orders of magnitude too small to be accounted for by radiative de-excitation of the π^-—p atom to the n = 1 state. The result is in agreement with a picture of capture from the s-state with $n \cong 4$ in π^-—p atoms, after collisional de-excitation and Stark effect mixing of the various l-levels during collisions with hydrogen atoms (Abstr. 13732 of 1959). J.D.Dowell

539.12

20208 THE NON-PHYSICAL REGION IN THE DISPERSION RELATIONS FOR THE PHOTOPRODUCTION OF π-MESONS. A.M.Baldin.

Zh. eksper. teor. Fiz., Vol. 39, No. 4(10), 1151-3 (Oct., 1960). In Russian.

The dispersion relations of Chew et al. (Abstr. 7438 of 1957) have been shown by Govorkov and the author in (Abstr. 5595 of 1960) to disagree with experiment. It is pointed out here that there may be a large contribution to the dispersion integrals from the non-physical region; this is due to the uncertainty of rapid convergence he Legendre polynomial expansion used (in cut-off form) in lytically continuing the amplitudes for $|\cos\theta| > 1$. A detailed lysis of experimental data shows that disagreement with experi- nt occurs only when the size of the non-physical region exceeds $\cong 0.1$, thus corroporating this view. It is then deduced that near eshold there is a significant contribution to photoproduction from non-resonance magnetic dipole transition amplitude M_{1-}.

D.W.L.Sprung

539.12

20209 LOW-ENERGY NEUTRAL PION PHOTOPRODUCTION IN H_2 AND He.

A.Odian, G.Stoppini and T.Yamagata.

ys. Rev., Vol. 120, No. 4, 1468-81 (Nov. 15, 1960).

The results of an experiment on the photoproduction of neutral ons from H_2 and He in the very low-energy region are compared th the dispersion relation calculations of Chew, Goldberger, Low, d Nambu (Abstr. 7438 of 1957). For H_2, agreement was found for ident γ-ray energies above 155 MeV for $N^+ \cong +0.065$ and disagree- ent below for all constant values of N^+. The He results give pport to the effective range formula of Chew et al. for the small wave phase shifts.

539.12

20210 PHOTO-PRODUCTION OF PION PAIRS BY POLARISED NUCLEONS.

S.K.Srinivasan and K.Venkatesan.

roc. Indian Acad. Sci. A, Vol. 50, No. 6, 392-7 (Dec., 1959).

It is found that the angular distribution of pion pairs is sensi- ve to the state of polarization of the incident photon beam.

539.12

20211 PHOTOPRODUCTION OF π-MESONS ON NUCLEONS IN PERIPHERAL COLLISIONS.

.B.Berestetskii and E.D.Zhizhin.

h. eksper. teor. Fiz., Vol. 39, No. 2(8), 418-26 (Aug., 1960). In ussian.

The photoproduction amplitudes are calculated in the one-meson nd two-meson approximations. For this purpose the dispersion elations are employed, together with the unitarity condition for the hotoproduction amplitude and its analytical properties. By employ- ng the corresponding experimental data and the relations deduced, ne can determine the $(\gamma\pi\pi\pi)$ vertex function near the point $t = 4\mu^2$ nd the π—nucleon coupling constant.

539.12

20212 A NOTE ON THE DISPERSION-THEORETIC APPROACH TO THE ONE ADDITIONAL PION PRODUCTION BY PION—NUCLEON COLLISION.

K.Ishida.

Progr. theor. Phys., Vol. 22, No. 4, 499-512 (Oct., 1959).

A "natural" frame of reference is introduced to derive the dispersion relation for the one additional pion production in pion—nucleon collisions. It is a natural extension of that introduced in elastic pion—nucleon scattering. Thus, the retarded matrix element may be derived to be analytic on the upper half-plane of the complex laboratory pion energy, fixing the other four independent variables. The dispersion relation connecting the dispersive parts and the absorptive parts is then derived. This relation may be used as the integral equation for the scattering matrix element. Finally, the absorptive parts are investigated.

539.12

20213 POSSIBLE ANOMALY IN MESON PRODUCTION IN P + D COLLISIONS.

A.Abashian, N.E.Booth and K.M.Crowe.

Phys. Rev. Letters, Vol. 5, No. 6, 258-60 (Sept. 15, 1960).

The He^3 momentum spectrum was measured at a fixed scattering angle of 11.7° for incident proton energies between 624 and 723 MeV. Each spectrum showed a high-energy peak due to the reaction $p + d \rightarrow He^3 + \pi^0$ and a lower-energy continuum due to double pion production. Comparison with a phase-space calculation revealed a peak on the upper edge of the continuum. Folding with a one-level Breit—Wigner formula gave a natural linewidth of 10 ± 6 MeV. The positions of the peaks correspond to a total energy for the level of 310 MeV, which might be a resonant π—π system or a new neutral particle. Comparison with the H^3 spectrum measured at the highest incident proton energy indicates that an I = 1 assignment to the peak is possible.

A.Ashmore

539.12

20214 PRODUCTION OF CHARGED MESONS BY 290 MeV π^--MESONS ON HYDROGEN.

Yu.A.Batusov, N.P.Bogachev, S.A.Bunyatov, V.M.Sidorov and V.A.Yarba.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 1, 52-5 (July 1, 1960). In Russian.

Angular and momentum distributions of secondary pions and neutrons in $\pi^- + p = \pi^- + \pi^+ + n$ reactions observed in NIKFI-BR emulsions are reported. The cross-section for the above reaction was found to be 0.61 ± 0.13 mb at 290 ± 15 MeV. In the c. of m. system, pions are emitted predominantly in the backward directions. The reverse is the case for neutrons.

S.Chomet

539.12

20215 ELECTROPRODUCTION OF π-MESONS.

R.Blankenbecler, S.Gartenhaus, R.Huff and Y.Nambu.

Nuovo Cimento, Vol. 17, No. 5, 775-85 (Sept. 1, 1960).

An approximate evaluation is made of the dispersion relations for the production of pions in electron—nucleon collisions. The results are applicable at low energies in the final pion—nucleon barycentric system where the assumption that the (3, 3) state dominates the dispersion integrals is expected to be valid. Effects due to nuclear recoil and crossing symmetry are treated exactly to all orders.

539.12

20216 PRONG ANALYSIS OF MULTIPLE PRODUCTION OF PIONS AT BEVATRON ENERGY ACCORDING TO A STATISTICAL THEORY.

F.Cerulus and J. von Behr.

Nuovo Cimento, Vol. 17, No. 5, 807 (Sept. 1, 1960).

See Abstr. 15416 of 1960. Gives the captions of the individual figures which were omitted in the original paper.

539.12

20217 MULTIPLE MESON PRODUCTION IN NUCLEON—ANTINUCLEON ANNIHILATIONS.

L.F.Cook, Jr and J.V.Lepore.

Phys. Rev., Vol. 120, No. 3, 1028-40 (Nov. 1, 1960).

A two-parameter model is proposed for treating complicated problems in a relatively simple way. It is assumed that the interaction may be characterized by a range of interaction and by a coupling strength. After the model is developed, it is applied to the problem of pion production in N-$\bar{N}$ annihilations. The two parameters are fixed by the experimental data for the multiplicity and energy spectra. It is found that all the data can be satisfied if one chooses the radius of interaction to be one pion Compton wavelength. Under certain restrictions the model reduces to the Fermi model.

539.12

20218 THE D-MESONS.

Syan' Din-Chan [Hsien Ting-Ch'ang].

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1627-9 (1960). In Russian.

Discusses processes favouring production of the D-mesons. Experiments are proposed to determine the spin and parity of the D-mesons.

539.12

20219 SEARCH FOR S = −2 NEGATIVE HEAVY MESON IN NUCLEAR EMULSIONS.

Y.Eisenberg, M.Friedmann, G.Alexander and D.Kessler.

Phys. Rev., Vol. 120, No. 3, 1021-2 (Nov. 1, 1960).

A search for the D^- meson (Abstr. 374, 2553 of 1960) was conducted in an emulsion stack exposed to the 300 MeV/c K^- beam at Berkeley. The stars initiated by the beam particles were investigated for possible emission of two strangeness-carrying particles, and in addition mass measurements were done on the short-range tracks. In about 10 000 events examined, no possible S = −2 particle was observed. Hence the upper limit for the D^- meson occurrence in the present experimental conditions is ~1/100 from the double strangeness observation and ~1/6000 from direct mass determinations.

539.12

20220 TESTS FOR $\Delta T = \frac{1}{2}$ IN $K^+ \rightarrow 3\pi$ AND $K_2^0 \rightarrow 3\pi$ DECAY MODES.

R.F.Sawyer and K.C.Wali.

Nuovo Cimento, Vol. 17, No. 6, 938-45 (Sept. 16, 1960).

The consequences are studied of the $\Delta T = \frac{1}{2}$ selection rule on the energy spectra of the pions in $K^+ \to 3\pi$, $K_2^0 \to 3\pi$ decay modes. Without any dynamical assumptions one can conclude that the π^+, π^0 spectra in $K^+ \to \pi^0 + \pi^0 + \pi^+$ and the π^0, π^+ (or π^-) spectra in $K_2^0 \to \pi^+ + \pi^- + \pi^0$ respectively should be the same. The effect of strong final state π—π interactions on the general structure of the decay amplitude is discussed and the possibility of detecting experimentally the presence of such strong interactions is suggested. The question of whether the experimental spectra provide a critical test of $\Delta T = \frac{1}{2}$ rule is also considered.

539.12

20221 ON THE LEPTONIC AND NON-LEPTONIC DECAY MODES OF K-MESONS.

J.C.Pati, S.Oneda and B.Sakita.
Nuclear Phys., Vol. 18, No. 2, 318-37 (Aug. (2), 1960).

An attempt has been made to explain the branching ratios of the various leptonic and non-leptonic modes of K-mesons decays in the framework of V—A four-fermion interaction, extended to the tetrahedron scheme. The non-leptonic modes have been investigated with the inclusion of a new class of diagrams for $\Lambda \to N + \pi$ decays, satisfying the strict $\Delta I = \frac{1}{2}$ rule, whose importance has been pointed already (Abstr. 11231 of 1960). Final state pion—pion interactions have been neglected. It it shown that all the relative rates (involving ratios between different decay rates) can be explained reasonably well (at least as far as the order of magnitude is concerned), if we assume consistently that the matrix element for any process, evaluated by perturbation theory, should be damped by a factor $\cong \sqrt{3}$, whenever a pion is emitted from a closed baryon-antibaryon loop. The observed features of the approximate $\Delta I = \frac{1}{2}$ rule in the non-leptonic modes of K-meson decays becomes easy to understand by showing the marked importance of the new class of diagrams for $\Lambda \to N + \pi$ decays, which enter as virtual processes for K-meson decays. It is also possible to explain the fact that the final state in $K^+ \to \pi^+ + \pi^- + \pi^+$ decay is predominantly symmetric between the three pions.

539.12

20222 A POSSIBLE NEUTRAL CASCADE MESON DECAY.

I.A.Ivanovskaya, E.V.Kuznetsov, E.I.Mal'tsev, A.Prokesh, G.M.Stashkov and I.V.Chuvilo.
Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 44-6 (July, 1960). In Russian.

An examination of 20 000 photographs obtained by irradiating a xenon bubble chamber with a beam of π^--mesons of 3 BeV/c momentum revealed an event which can be interpreted as a decay of a heavy neutral meson according to the scheme

$$D^0 \to K^+ + \pi^- + Q.$$

The mass of this particle computed on basis of the K^+ and π^- meson momenta, was found to be $m(D^0) = (660 \pm 50)$ MeV.

539.12

20223 FOUR-PRONG DECAY OF THE LONG-LIVED K^0 MESON.

É.O.Okonov, N.I.Petrov, L.M.Rozanova and V.A.Rusakov.
Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 67-9 (July, 1960). In Russian.

Among 140 decays of long-lived K_2^0-mesons observed in a cloud chamber, a four-pronged star was observed which most probably can be interpreted as a $K_2^0 \to \pi^+ + \pi^- + \pi^0$ decay with a subsequent $\pi^0 \to \gamma + e^+ + e^-$ decay.

539.12

20224 SPECTRA OF K_{e4} AND $K_{\mu 4}$ DECAYS.

E.P.Shabalin.
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 345-54 (Aug., 1960). In Russian.

The electron and π-meson energy spectra and the π—e angular correlation in $K \to 2\pi + e + \nu$, and also the μ-meson spectrum and the spectrum of the effective mass of the two π-mesons in $K \to 2\pi + \mu + \nu$ were obtained. The K_{e4} decay probability is 0.8×10^{-3} of the K_{e3} decay probability. The $K_{\mu 4}$ decay probability is smaller than that for K_{e4} decay by an order of magnitude.

539.12

20225 PION—PION EFFECTS IN τ-DECAY.

A.N.Mitra.
Nuclear Phys., Vol. 18, No. 3, 502-15 (Sept. (1), 1960).

The effects of pion-pion interactions in resonant form in the s-states of isobaric spins 0 and 2 were studied in some detail with respect to the energy and angular distributions of the unlike pions in τ-decay. The relation of the resonance picture with that of the more conventional effective range theory of pion—pion interactior was clarified. It was found that the pion—pion hypothesis is capab of explaining the observed distribution in a variety of ways, depen ing on the choice of the resonance parameters. In particular, an I = 0 interaction is by no means ruled out by experiment. Howeve on the basis of the present τ-decay data, and in the absence of ind pendent information on the nature of the pion—pion interaction, it w not possible to distinguish between the various alternatives.

539

20226 METHOD FOR DETERMINING THE K^0 SPIN.

P.Eberhard and M.L.Good.
Phys. Rev., Vol. 120, No. 4, 1442-9 (Nov. 15, 1960).

The method uses only angular momentum conservation and th rules of quantum mechanics. It is based on a proof that, in the reaction $\pi^- + p \to \Lambda + K^0$, the K_1^0 decay intensity associated with given direction of the Λ spin cannot be isotropic at any production angle, if the K^0 spin is equal to or greater than two. Account is ta of the particle-mixture aspect of the K_1^0 and of possible magnetic moment precession.

539.

20227 ON THE RELATIVE PARITY OF CHARGED AND NEUTRAL K MESONS.

K.Fujii and H.Tanaka.
Progr. theor. Phys., Vol. 22, No. 5, 704-14 (Nov., 1959).

The assumption is made that the mass different between the particles belonging to the same charge multiplet is mainly due to the oddness of the relative parity between charged and neutral K-mesons, i.e., p(K) = odd; it is then shown, on the basis of a perturbation calculation, that this assumption is permissible unde certain conditions. One of them is the equality of the relative parities of Λ, Σ's and Ξ's. This perhaps does not suffer any chan even when any higher-order contribution of the perturbation expansion is taken into account. In order to obtain information ab the parities of charged and neutral K-mesons, various effects due to p(K) = odd, such as the mass difference between charged and neutral K-mesons, are investigated. The result thus obtained is not inconsistent with $P(K^\pm)$ = odd, which may be in agreement w the result obtained from the $K^\pm$—nucleon scattering experiment; the most favourable parity assignment to K-mesons is $P(K^+)$ = odd and $P(K^0)$ = even. Further, a comment based on the viewpoint of P(K) = odd is made about the implicit assumption that the baryon spectrum known at present is closed.

539.1

20228 INTERACTIONS OF 1.15 GeV/e K^--MESONS IN EMULSION. I.

C.M.Garelli, B.Quassiati and M.Vigone.
Nuovo Cimento, Vol. 17, No. 5, 786-801 (Sept. 1, 1960).

The results are reported of an analysis of 1675 interactions of high energy K^--mesons with the emulsion nuclei. The main results concern the emission of charged hyperons, their energy and angulai distribution, the ratio (Σ^- emitted)/Σ^+ emitted); an estimate is given of the probability of Σ inelastic re-emission.

539.1

20229 $K\pi$ INTERACTION IN THE DOUBLE DISPERSION REPRESENTATION.

B.W.Lee.
Phys. Rev., Vol. 120, No. 1, 325-30 (Oct. 1, 1960).

The low-energy $K\pi$ interaction is studied on the basis of the double dispersion representation. Exact dispersion relations for partial wave amplitudes are derived for $K\pi$ scattering and for the process $\pi + \pi \to K + \bar{K}$. These relations are reduced to manageable form and effect-range formulae are derived under the assumption that the $K\pi$ interaction proceeds principally through a contact "potential". For the process $\pi + \pi \to K + \bar{K}$, the initial-state interaction is taken into account; for the p-wave of $K\pi$ scattering, the two-pion exchange mechanism is considered. Other types of solutions are briefly discussed.

539.1

20230 A NOTE ON THE SIGNS OF THE $K^\pm$—p INTERACTIONS.

Y.Nogami.
Progr. theor. Phys., Vol. 22, No. 6, 899-901 (Dec., 1959).

The signs of the interactions are determined assuming ps ($N\Lambda K$) and ($N\Sigma K$) couplings and replacing the Born term in the Low equation by an effective scattering interaction. J.E.Pator

539.12

31 THE SIGN OF THE K^-—NUCLEUS POTENTIAL.
P.B.Jones.

Roy. Soc. A, Vol. 257, 109-14 (Aug. 23, 1960).
ıe small-angle elastic scattering of K^--mesons by the nuclei
ographic plates was measured in the energy interval 106 to
›V. The experimental reaction cross-section and elastic
ntial cross-section were compared with cross-sections ob-
from the optical model of the nucleus by exact numerical
›n of the Klein—Gordon equation at 125 MeV. If the potential
(Woods and Saxon, 1954) is $r_0 = 1.07A^{1/3} \times 10^{-13}$ cm, the most
›le value of the real part of the potential is $U = -30$ MeV.
$= 1.20A^{1/3} \times 10^{-13}$ cm, $U = -16$ MeV. The experimental
of U appear to resolve the sign ambiguity in the real parts
K^--nucleon s-wave scattering lengths.

539.12

232 SIGN OF THE NUCLEAR POTENTIAL FOR THE K^+-MESON. T.G.Lim and P.G.van Breeman.

Cimento, Vol. 17, No. 6, 887-92 (Sept. 16, 1960).
'he sign of the nuclear potential for the K^+-meson was deter-
l from the small angle distribution of the elastic scattering
5 nuclear èmulsion. The investigation was carried out in the
inetic energy region (≲ 60 MeV). The Born approximation has
applied to analyse the data and it is found that the nuclear
tial is repulsive.

539.12

233 TEST OF GLOBAL SYMMETRY FROM MULTINUCLEON K^--CAPTURE. S.S.Saxena and S.N.Biswas.

Cimento, Vol. 17, No. 5, 749-56 (Sept. 1, 1960).
'he principle of charge-independence coupled with the unitarity
me-reversibility of the scattering matrix enables one to express
›oduction amplitude of the K^--capture reactions in terms of the
›ring phases of the final state interaction. By making impulse
ıpproximation, certain relations between $K^- + d$ and $K^- + 2N$
›ption cross-sections are obtained. The experimental data have
analysed on the basis of the global symmetry of strong inter-
ns. It is found that within the limits of approximation this
netry is incompatible with the experimental observations.

539.12

234 SEPARATED 1.17-BeV/c K^- MESON BEAM.
P.Eberhard, M.L.Good and H.K.Ticho.

sci. Instrum., Vol. 31, No. 10, 1054-63 (Oct., 1960).
This report describes the design and testing of a 1.17 BeV/c
rated K^- beam designed in 1958 in connection with a 15 in.
›gen bubble chamber experiment. At the target the K^-/π^- ratio
1/140. At the chamber, 4.0 K^--meson decay lengths from the
t, and after two stages of electromagnetic separation, the
ratio was 12.5, corresponding to a total pion suppression by
tor of about 10^5. The K^- flux at the chamber was 0.87 K^-
›ns per 10^{10} protons impinging on the target.

erons

539.12

20235 DECAY OF $\Lambda_0 \rightarrow n + \gamma$ THROUGH NON LOCAL FERMI INTERACTIONS DUE TO VECTOR MESONS. J.L.Acioli.

Acad. Brasil Cienc., Vol. 32, No. 1, 9-16 (1960).
It is found that the branching ratio of $\Lambda_0 \rightarrow n + \gamma$, with respect
he experimental pionic decay mode $\Lambda_0 \rightarrow n + \pi_0$, can be of the order
10^{-4}.

539.12

20236 DECAY ASYMMETRY OF Σ^+ AND Λ^0 HYPERONS.
B.Cork L Kerth, W.A.Wenzel, J.W.Cronin and R.L.Cool.

s. Rev., Vol. 120, No. 2, 1000-4 (Nov. 1, 1960).
Counter techniques were used to measure decay asymmetries for
arized Λ^0 and Σ^+ hyperons. The Σ^+ hyperons were produced by
3 BeV/c π^+ in the reaction $\pi^+ + p \rightarrow \Sigma^+ + K^+$. The Λ^0 hyperons
re produced by 1.00 BeV/c $\pi^+ + d \rightarrow K^+ + \Lambda^0 + p$. The asymmetry
each hyperon decay mode was measured with a counter arrange-
nt which detected separately charged pions and γ-rays from
tral pions. The protons from the hyperon decay were also
tected to confirm the identification of the decay modes. The
duct αP was measured, where α is the asymmetry parameter and P is the average polarization of the hyperon. The following results were obtained for the various decay modes:

$$\Sigma^+ \rightarrow \pi^+ + n, \qquad \alpha P = +0.03 \pm 0.08;$$
$$\Sigma^+ \rightarrow \pi^0 + p, \qquad \alpha P = +0.75 \pm 0.17;$$
$$\Lambda^0 \rightarrow \pi^- + p, \qquad \alpha P = +0.55 \pm 0.06;$$
$$\Lambda^0 \rightarrow \pi^0 \qquad \alpha P = +0.60 \pm 0.13.$$

The results for Σ^+ are fitted to the triangular relationship demanded by the $\Delta I = \frac{1}{2}$ rule, and absolute values for the asymmetries of $\Sigma^\pm$ decay are predicted. The ratio

$$\alpha(\Lambda^0 \rightarrow \pi^0 + n)/\alpha(\Lambda^0 \rightarrow \pi^- + p) = +1.10 \pm 0.27$$

is in agreement with the value +1.00 predicted by the $\Delta I = \frac{1}{2}$ rule for hyperon decay.

539.12

20237 LEPTON DECAYS OF HYPERONS.
D.R.Harrington.

Phys. Rev., Vol. 120, No. 4, 1482-5 (Nov. 15, 1960).

An expression is given for the lepton energy spectrum and asymmetry for the lepton decay modes of hyperons in terms of 6 form factors. A weak interaction having the form of the usual lepton current coupled to an unspecified strong current is assumed, and the momentum transfer dependence of the form factors is neglected. Some applications to the decays $\Lambda \rightarrow p + e + \nu$ and $\Lambda \rightarrow p + \mu + \nu$ are given.

539.12

20238 A NOTE ON THE DECAY OF THE CASCADE HYPERON.
I.Y.Kobzarev, L.B.Okun' and A.P.Rudik.

Zh. eksper. teor. Fiz., Vol. 38, No. 3, 1012-13 (March, 1960). In Russian.

A polarization analysis of the cascade hyperon decay $\Xi \rightarrow \Lambda + \pi$ is indicated which would enable the s- and p-wave Λ—π scattering phases to be determined. J.S.Dowker

539.12

20239 PROPERTIES OF THE AXIAL VECTOR INTERACTION AND $\Sigma \rightarrow \Lambda + e + \nu$ DECAY. L.B.Okun'.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 214-16 (July, 1960). In Russian.

A relation between the probability of this decay, the $\Sigma\Lambda\pi$ coupling constant, and known constants, is deduced from a postulated expression for the divergence of the strangeness conserving current due to Polkinghorne (Abstr. 3701 of 1958). D.W.L.Sprung

539.12

20240 THE $\Sigma^0 \rightarrow \Lambda^0 + 2\gamma$ DECAY AND THE MAGNETIC MOMENT OF THE Σ^0-HYPERON.
L.B.Okun' and A.P.Rudik.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 378-83 (Aug., 1960). In Russian.

The possibility of determining the magnetic moment of the Σ^0-hyperon by comparing the $\Sigma^0 \rightarrow \Lambda^0 + 2\gamma$ and $\Sigma^0 \rightarrow \Lambda^0 + \gamma$ decays is examined.

539.12

20241 THE MASS OF THE Λ^0 HYPERON.
J.Lodge, F.Anderson, E.B.Brucker, A.Pevsner and R.Strand.

Nuovo Cimento, Vol. 18, No. 1, 147-53 (Oct. 1, 1960).

The mass of the Λ^0-hyperon was measured using nuclear emulsions and the following result obtained $M_\Lambda = (1115.55 \pm 0.15)$ MeV.

539.12

20242 PHENOMENOLOGY OF Σ—NUCLEON SCATTERING.
M.T.Vaughn.

Nuovo Cimento, Vol. 18, No. 1, 178-90 (Oct. 1, 1960).

A discussion is given of some phenomenological aspects of Σ—nucleon scattering. It is noted that with Σ^+ beams likely to be available in the near future, triple scattering experiments are only slightly more difficult than single scattering experiments. A method of determining separately ^1S and ^3S phase-shifts at low energies is noted. A discussion is given of the qualitative features of low-energy

Σ—nucleon scattering to be expected if one or the other of the global symmetry models $G_{\pi\Sigma} \cong \pm G_{\pi N}$ is valid, and possibilities of distinguishing between the two cases are examined, utilizing the Mandelstam representation for the scattering amplitude, some consequences of which are derived in the appendix. In particular, the analytic properties of the partial wave amplitudes are deduced; it is found that owing to the unequal masses of Σ and nucleon, the singularities of the partial wave amplitudes do not all lie on the real axis in the complex plane of the energy variable.

Strange particles

539.12

20243 ANALYTICAL PROPERTIES OF THE SCATTERING AMPLITUDE FOR INELASTIC PROCESSES INVOLVING STRANGE PARTICLES.

I.T.Todorov.

Nuclear Phys., Vol. 18, No. 3, 521-8 (Sept.(1), 1960).

The analytical properties of the amplitudes for the processes ($N + \bar{K} \rightarrow Y + \pi$) and ($N + \pi \rightarrow Y + K$) are considered on the basis of the principles of covariance, causality and spectrality. Kinematic characteristics of these processes are obtained in a frame of reference which is a natural generalization of the Breit system Dispersion relations are derived for imaginary meson masses. The Vladimirov--Logunov theorem (1959) concerning the analyticity of the anti-Hermitian part of the amplitude is extended to the case when all particles involved in the reaction possess different masses. In accordance with the results of previous investigations (Abstr. 10612 of 1959) the region thus obtained contains no physical point.

Deuterons

539.12 : 539.14

ELECTRIC QUADRUPOLE MOMENT OF THE DEUTERON.

See Abstr. 20332

539.12

20244 INVESTIGATION OF THE SPECTRA OF NEUTRONS EMITTED IN THE DISINTEGRATION OF DEUTERONS BY PROTONS.

V.V.Komarov and A.M.Popova.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1559-63 (1960). In Russian.

The energy spectra of neutrons emitted at angles of 0° and 180° in the c.m.s. from the $p + d \rightarrow p + p' + n$ reaction are calculated for a total energy of the reaction of ~4 MeV, with pair interaction of nucleons in the final state being taken into account. Considers application of this method for calculation of the energy distributions of reaction products when several particles are emitted for the purpose of ascertaining the role of particle interactions in the final states.

539.12

20245 DEUTERON PRODUCTION IN HIGH-ENERGY COLLISIONS.

R.Hagedorn.

Phys. Rev. Letters, Vol. 5, No. 6, 276-7 (Sept. 15, 1960).

Calculates deuteron production in high-energy p—p collisions, on the statistical theory, including the fact that the interaction volume is smaller than the deuteron. The result has the right order of magnitude to account for production data in complex nuclei at 25 GeV.

R.J.N.Phillips

Tritons

539.12 : 539.17

20246 ABSOLUTE MEASUREMENT OF THE $T^3(p,n)He^3$ REACTION THRESHOLD ENERGY AND THE NEUTRON—HYDROGEN MASS DIFFERENCE.

R.O.Bondelid, J.W.Butler, C.A.Kennedy and A.del Callar.

Phys. Rev., Vol. 120, No. 3, 887-9 (Nov. 1, 1960).

The threshold energy of the $T^3(p,n)He^3$ reaction was precisely measured with a 2-meter radius electrostatic analyser, calibrated by absolute methods. A clean tritiated zirconium target, protected from vacuum-system contaminants, was bombarded by protons having energy inhomogeneities as low as 0.02%. The result, obtained by an extrapolation of (net neutron counts)$^{2/3}$, gives a threshold value of 1019.7 ± 0.5 keV, a reaction Q value of −764.3 ± 0.4 keV, and a neutron—hydrogen mass difference of 782.9 ± 0.4 keV.

Alpha-particles

20247 HIGH ENERGY n—He^4 SCATTERING.

Y.Sakamoto and T.Sasakawa.

Progr. theor. Phys., Vol. 22, No. 2, 299-301 (Aug., 1959).

A calculation is carried out in impulse approximation for 9 neutrons using a Gaussian wave-function for He^4. Similar cros sections and polarization were obtained from Gammel—Thaler phases and those of an unspecified meson-theoretical potential.

D.W.L.

5

20248 NOTE ON ELECTRODISINTEGRATION OF He^4.

T.Muto, T.Sebe, and K.Izumo.

Progr. theor. Phys., Vol, 22, No. 2, 304-7 (Aug., 1959).

Calculations are compared with experiments using 400 Me electrons, for scattering angles of from 45° to 105° in 15° steps With suitable normalization, agreement is good except at 45°. suggested that at small angles deuteron ejection competes with nucleon emission. The calculations indicate that the indirect p gives a very small contribution compared with the direct.

D.W.L.S

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20249 FINE STRUCTURE IN THE ENERGY SPECTRA OF PHOTOPROTONS FROM He^4.

C.Milone.

Phys. Rev., Vol. 120, No. 4, 1302-5 (Nov.15, 1960).

The energy spectra of the photoprotons from He^4 irradiate with 31 and 32 MeV bremsstrahlung were studied by means of nuclear photoemulsions in $\Delta E\gamma$ steps of 0.133 MeV. In the regi of the giant resonance several peaks were distinguished. The m evident of these have widths less than 0.5 MeV and are located He^4 excitation of 24.7 ± 0.2 and 26.1 ± 0.1 MeV. Previous expe ments on the photoproton spectra from He^4 could not give evide of these narrow resonances because the spectra were examined energy steps much larger than the width of these resonances. O types of experiments which have been performed in order to obt information on the existence of excited states in He^4 are discuss The fact that narrow resonances are distinguished only in the pr experiment is attributable to the selective nature of the (γ,p) pro the most important contribution in the $He^4(\gamma,p)$ reaction coming from the states of He^4 having $J = 1^-$ and $T = 1$.

53

20250 THE SCATTERING OF 29 MeV ^3He-PARTICLES BY ^1H, ^2H, ^3He AND ^4He NUCLEI.

D.J.Bredin, J.B.A.England, D.Evans, J.S.C.McKee, P.V.March, E.M.Mosinger and W.T.Toner.

Proc. Roy. Soc. A, Vol. 258, 202-14 (Oct. 18, 1960).

Angular distributions for the scattering of 29 MeV He^3 parti by light nuclei were observed using a photographic-plate metho Absolute differential cross-sections for elastic scattering, and inelastic processes for H^2, He^3 and He^4 nuclei, were found withi the centre-of-mass angular range 20 to 150°. The elastic scattering distributions for the H^1 and He^3 nuclei were compared wi predictions based on resonating group theory.

539.12 : 53

MEASUREMENT OF SURFACE DENSITY OF THIN FOILS α-PARTICLE TRANSMISSION LOSS.

See Abstr. 19039

COSMIC RAYS

(Nuclear reactions due to cosmic rays are included under Nuclear Reactions)

537.59 : 550.3 : 551.5 : 5

A UNIFIED THEORY OF TERRESTRIAL AND SOLAR MAGN ZATION, THE OUTER VAN ALLEN BELT AND HIGH ENERGY PRIMARY COSMIC RAYS.

See Abstr. 18473

537.59 :

20251 THE RECOVERY OF COSMIC-RAY EMULSIONS FR ROCKET AND SPACE PROBES.

H.Yagoda.

Phys. Today, Vol. 13, No. 10, 18-25 (Oct., 1960).

537.59

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A LARGE MULTIPLATE CLOUD CHAMBER FOR COSMIC RAY OBSERVATION.

ke, K.Hinotani, I.Katsumata and T.Kaneko.
;. Soc. Japan, Vol. 14, No. 11, 1471-4 (Nov., 1959).
ie chamber was constructed for the observation of extensive
›wers caused by extremely high energy cosmic rays. Its
ions of sensitive volume are 200 cm wide, 130 cm high and
deep. It contains 21 sheets of lead plate of 1 cm thick, so that
al thickness of the absorber corresponds to about 48 radiation
or about three times of nuclear interaction mean free path.
sign and method of operation are reported.

537.59

53

HODOSCOPE SYSTEM FOR EXPERIMENTS ON THE SCATTERING OF COSMIC RAY μ-MESONS.

CTRONIC CIRCUITS. M A.Meyer, P.H.Stoker and J.A.M.De
s.
r Instrum., Vol. 3, No. 5, 278-84 (Nov., 1958).
description is given of the electronic circuits of a large
ope system which is being used in experiments on the scatter-
u-mesons. The principle of the method employed is to deter-
ne direction of the trajectory of the particle before and after
ing by means of three systems of crossed counters. The
rs through which the particle has passed are identified by
of neon lamps.

537.59

:54

HODOSCOPE SYSTEM FOR EXPERIMENTS ON THE SCATTERING OF COSMIC RAY μ-MESONS.

RFORMANCE OF THE HODOSCOPE.
leyer and J.A.M.De Villiers.
ır Instrum., Vol. 3, No. 5, 285-91 (Nov., 1958).
he performance of the hodoscope described in Pt I (see pre-
abstract) is analysed in detail. Spurious scattering is shown
ıbout 0.1% of the total counting rate. This inefficiency arises
t entirely from casual coincidences.

537.59

255

COSMIC RADIATION: THE PRIMARY PARTICLES.

J.G.Wilson

mporary Physics, Vol. 1, No. 3, 204-19 (Feb., 1960).
›bservations of primary cosmic-ray particles entering the
atmosphere show that the solar system is situated in an iso-
: flow of protons and of heavier nuclei, and that these particles
energy which can vary from small values to values so great
ie upper limit of energy carried by a single particle, cannot
›sent be defined. These primary particles are constrained to
e through the galaxy as if in a reservoir and must initially
›een injected into the reservoir from specific sources. In
ways the turbulent clouds which remain at the site of eruption
›ernovae meet the requirements of such sources, and this
rty can be related to the identification of these objects as
es of strong radio-emission or radio-stars.

537.59

256

THE DETERMINATION OF THE FLUX OF COSMIC RAY PROTONS WITH NUCLEAR EMULSIONS.

/addington.
/Mag. (Eighth Ser.), Vol. 5, 1105-17 (Nov., 1960).
The flux of protons in the primary cosmic radiation was
mined in a stack of nuclear emulsions during 1954 over
ern Italy. This determination, which depended on the observa-
of the nuclear interactions produced by the protons, gave a flux
: top of the atmosphere of 500 ± 70 protons m^{-2} $sterad^{-1}$ sec^{-1},
ıe in good agreement with that expected from counter measure-
s. A simple model of the variation of the proton flux with
in the atmosphere was derived which appears to be in
›nable agreement with the experimental data.

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0257

ON AN ATTEMPT OF DETECTION OF PRIMARY COSMIC PHOTONS OF VERY HIGH ENERGY.

ıze and A.Zawadzki.
o Cimento, Vol. 17, No. 5, 625-33 (Sept. 1, 1960).
In relation to the primary proton flux of very high energy
-10^{16} eV), the possible photon flux of equal energy created by
—p collisions of protons with the diffused matter of the
erse, is evaluated taking into account the multiple production of the π^0-mesons and their decay. If a trace of very high energy photons exists among the primary flux, two types of extensive air showers (EAS) must be produced in the air: (1) ordinary EAS; (2) pure photon—electron cascades. Taking advantage of the difference between the number of electrons produced at sea level by a protonic and by a photonic EAS of equal energy (therefore resulting in an amplification factor of the observable effect by at least ten times) it is shown that it is possible to separate these two types by studying the penetrating component with the help of a large detection area and to disclose a real limit rate as small as 10^{-4}. Considering current cosmological estimates, it gives some possibility of observing a significant rate. This method therefore may give new experimental information on the origin of cosmic rays and on individual interaction at very high energy.

537.59

20258

A METHOD FOR DETECTING THE POSSIBLE EXISTENCE OF HIGH ENERGY DEUTERONS IN THE PRIMARY COSMIC RADIATION.

R.R.Daniel, P.J.Lavakare and P.K.Aditya.

Nuovo Cimento, Vol. 17, No. 6, 837-44 (Sept. 16, 1960).

The suggested method takes advantage of the fact that when only the neutron of the incoming deuteron takes part in a collision and gives rise to a star in a nuclear emulsion, the proton continues in the forward direction almost undeviated. Such stars, referred to as (d, p) stars, can provide evidence that the incoming particle is a deuteron. In order to use this method it is necessary to know: (i) the interaction mean free path λ_d of high energy deuterons in nuclear emulsions; and (ii) the proportion f(d, p) of deuteron induced interactions in which only the neutron takes part. These have been determined to be $\lambda_d = 15.8$ cm and f(d, p) = 0.4. The suggested method is applicable if deuterons constitute $>\sim 5\%$ of the singly charged particles in the primary radiation.

537.59

20259

ON THE INTERPRETATION OF COSMIC RAY μ-MESON DATA.

D.Stern.

Nuovo Cimento, Vol. 18, No. 1, 1-8 (Oct. 1, 1960).

An analysis is carried out of the extent to which primary interactions can be investigated using data obtained from cosmic-ray μ-mesons. The analytic dependence of the μ-meson flux at various depths and energies is developed and computations about the energy distribution of pions in primary interactions are carried out. The results agree with a power law lab-system energy distribution.

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20260

THE RELATIVE ABUNDANCES OF COSMIC RAY NUCLEI OF CHARGE $Z \geq 3$.

I.J.van Heerden and B.Judek.

Canad. J. Phys., Vol. 38, No. 7, 964-7 (July, 1960).

The charge spectrum of the heavy nuclei in the primary cosmic radiation was re-examined and a value of 0.20 ± 0.02 obtained for the relative abundance of light nuclei, in agreement with previous work.

S.J.St-Lorant

537.59

20261

THE RELATIVE ABUNDANCES OF THE HEAVY NUCLEI IN THE PRIMARY COSMIC RADIATION.

C.J.Waddington.

Phil. Mag. (Eighth Ser.), Vol. 5, 311-23 (April, 1960).

In an attempt to resolve the present controversy about the relative abundances of the heavy, $Z \geq 6$, nuclei in the primary cosmic radiation, the magnitude of the corrections introduced by the overlying atmosphere was redetermined. For this reason it was necessary to use nuclear emulsions to determine the fragmentation parameters of nuclei having $20 \leq Z \leq 28$. The results of this work show that the relative abundances calculated previously by considering the diffusion of nuclei through the atmosphere were not seriously in error, and that outside the atmosphere the ratio of H, $Z \geq 10$, to M, $6 \leq Z \leq 9$, nuclei is 0.38 ± 0.04. The significance of this result is considered briefly.

537.59

20262

ON THE DETECTION OF COSMIC RAY AIR SHOWERS BY MICROWAVE TECHNIQUES.

I.Segal.

Bull. Res. Coun. Israel, Vol. 9F, No. 1, 17-30 (June, 1960).

The amount of energy radiated from a shower in the form of Cherenkov radiation and bremsstrahlung is calculated. The expressions used are based on "Approximation B" of the shower theory, taking into account the contributions of successive generations. The calculations show that in the region $\nu = 10^{10}$ c/s bremsstrahlung exceeds Cherenkov radiation by approximately an order of magnitude, and showers of energy greater than 10^{17} eV should be detected by sensitive microwaves techniques.

537.59

20263 THE NATURE OF BEAMS OF PARTICLES IN THE CORE OF AN EXTENSIVE ATMOSPHERIC SHOWER.

S.N.Vernov, I.P.Ivanenko, G.V.Kulikov and G.B.Khristiansen.
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 509-12 (Aug., 1960).
In Russian.

Whilst investigating the structure of the core of a shower with a cloud chamber, narrow beams consisting of from 4 to 15 particles with colinear trajectories were discovered. Using experimental data obtained earlier, it is shown that the particles more probably form groups of high energy μ-mesons than the cores of electron—photon showers arising from π^0-mesons. G.A.Chisnall

537.59

20264 ELECTRON NUMBER DISTRIBUTION IN ELECTRON—PHOTON SHOWERS IN AIR AND ALUMINIUM ABSORBERS.

J.C.Butcher and H.Messel.
Nuclear Phys., Vol. 20, No. 1, 15-128 (Oct. (2), 1960).

Numerical results for the number distribution, average numbers and variance of electrons above a given energy due to primary electrons and photons are presented for air and aluminium absorbers. The 276 tables cover the cases of electron and photon primary energies E_0 = 50, 100, 200, 500, 1000, 2000, 5000, 10 000 20 000 and 50 000 MeV, and electron secondary energies E = 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10 000 and 20 000 MeV with depths ranging from zero to 10 radiation lengths. The more accurate Bethe—Heitler cross-sections at low energies were used and collision losses and Compton effect were taken into account. Scattering at low energies was neglected for the present low atomic number absorbers. The results were obtained using Monte Carlo methods on the electronic digital computer SILLIAC. In every case at least 1000 showers were followed to obtain the present numerical values.

537.59

20265 ENERGY SPECTRA OF THE ELECTRON—PHOTON COMPONENT IN EXTENSIVE AIR SHOWERS NEAR THE SHOWER AXIS.

O.I.Dovzhenko, S.I.Nikolskii and I.V.Rakobol'skaya.
Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1361-9 (1960). In Russian.

A cloud chamber with lead plates was employed to investigate the electron—photon component of extensive air showers at sea level. Showers containing on the average 8×10^3, 1.2×10^4 and 3×10^4 particles and passing at distances of 0-3 m from the chamber were selected. Energy spectra of the electron—photon component were derived and the fraction of high-energy electrons and photons in range of 0-3 m and 0-0.3 m from the shower axis was determined. The spatial distribution of high-energy electrons and photons for distances of 0-0.3 m from the axis has also been obtained.

537.59

20266 OBSERVATIONS ON EXTENSIVE AIR SHOWERS. VIII. THE DISTRIBUTION IN DECLINATION AND CURVATURE OF THE SHOWER FRONT.

E.F.Bradley and N.A.Porter.
Phil. Mag. (Eighth Ser.), Vol. 5, 305-10 (April, 1960).

For Pt VII see Abstr. 378 of 1959. A directional Cerenkov counter was used at latitude 52° N to separate shower directions into two classes, incident from North and South of the East—West plane through the zenith. Evidence from some previous experiments indicates a Northern excess of approximately 30%. No excess was observed; out of 526 showers, each containing at least 3×10^6 particles at sea level, 261 were incident from the North, and 265 from the South. The apparent direction of a shower was found to be dependent on the position of its axis relative to the detector. A directional radius of curvature was measured, making reasonable assumptions, and found to be $1625 \pm {}^{505}_{290}$ metres.

537.59

20267 FLUCTUATIONS IN THE ANGULAR DISTRIBUTION OF SECONDARY PARTICLES OF EXPLOSIVE SHOWERS.

B.A.Nikol'skii, and A.P.Mishakova.
Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1507-11 (1960). In Russian.

Reports calculations of the fluctuations in the angular distribution of shower particles which imitate the "double-centr shower production mechanism. It was concluded that most experimentally observed showers possessing a "double-centre" angular distribution can be explained by natural statistical fluctu tions in the angular distribution. The calculations were perform by the Monte Carlo method.

537

20268 MOMENTARY BURSTS OF COSMIC RADIATION.

A.K.Das and J.V.Narayana.
Indian J. Meteorol. Geophys., Vol. 11, No. 1, 50-6 (Jan., 1960).

A Kolhörster apparatus operated continuously since March 1 at Kodaikanal (geomagnetic latitude: 0°.6 N) was used to record Hoffmann bursts. The great majority of the bursts are found to follow solar flares after a time-lag of 10 to 100 minutes; no corr tion is found between the importance of a flare and the associated burst activity or the geomagnetic storm which it causes.

P.K.Ka

537.5

20269 PION CLOUD EFFECTS AND THE TWO-CENTER MODEL OF COSMIC RAY JETS.

E.M.Friedländer.
Phys. Rev. Letters, Vol. 5, No. 5, 212-13 (Sept. 1, 1960).

An attempt is made to interpret the two-cone structure of cosmic-ray jets using the fact that recent investigations of high-energy nuclear interactions have shown that at energies above 1 BeV an important part is played by peripheral collisions involvi one or two pions in the meson cloud of the colliding nucleons.

C.F.Barna

537

20270 ON THE AZIMUTHAL DISTRIBUTION OF MESON JE

E.Balea, E.Friedländer and C.Potoceanu.
Rev. de Physique (Bucarest), Vol. 4, No. 4, 441-4 (1959).

An analysis of 22 jets produced by protons, and four α and tw heavy primary jets, confirms the existence of a preferential plan for proton jets defined by the direction of motion of the two nucle before the collision. For the other jets the azimuthal distribution of mesons was uniform. E.J.Bur

537

20271 STATISTICAL SIGNIFICANCE OF DOUBLE MAXIMU ANGULAR DISTRIBUTION IN HIGH-ENERGY JETS.

J.Gierula, M.Mięsowicz and P.Zieliński.
Acta phys. Polon., Vol. 19, No. 1, 119-21 (1960).

An analysis of the 56 available jets generated by single nucle with energy $> 10^{12}$ eV confirms the existence of two maxima in the angular distribution for $\sigma > 0.6$ (35 events) but a simple Gauss for $\sigma < 0.6$ (21 events). E.J.Bur

537

20272 A JET SHOWER WITH ENERGY OF 5×10^{13} eV FOU IN EMULSION CHAMBER.

K.Nishikawa.
J. Phys. Soc. Japan, Vol. 14, No. 7, 880-7 (July, 1959).

A high energy jet shower suitable for detailed analysis was found in one of the emulsion chambers flown in 1956 in the "Emulsion Chamber Project". The charged secondary particles this jet were analysed and the energies of π^0-mesons were determined by making use of cascade showers developed from the γ-ra decayed from these π^0-mesons. The energies of incident particle were obtained by the median angle method, and were estimated to 5×10^{13} eV ($\gamma_C = 165$). Next, by making use of the fact that the transverse momenta of points are constant and by analysing casca showers developed from γ-rays produced by the decay of π^0-meso the energies of secondary particles were estimated. It was found that the differential momentum spectrum obtained is of the form dP/P^3. Inelasticity coefficients K', K'' and K in the definition of t Bristol group were estimated to be 0.15, 0.10 and 0.5 respectively The results of the present analysis were compared with various theories.

537.

20273 THE ABSORPTION COEFFICIENT OF THE MESON COMPONENT OF THE COSMIC RADIATION.

B.Betev, G.Bozóki and E.Fenyves.
C.R. Acad. Bulg. Sci., Vol. 13, No. 3, 257-60 (May-June, 1960).
In German.

The coefficient was measured by a hodoscoped and shielded G—M counter telescope array. Pressure and height corrections examined. E.W.Kellerm

537.59

274

MEAN FREE PATH OF PRIMARY COSMIC RAYS IN THE ATMOSPHERE.

R.W.Williams.

) Cimento, Vol. 16, No. 4, 762-4 (May 16, 1960).

'he interaction mean free path of nucleons in air has been lated as a function of elementary nucleon—nucleon cross-section. sing an effective nucleon—nucleon cross-section of about 25 mb, it concluded that the interaction mean free path of cosmic rays value near 100 g cm^{-2} with an uncertainty of 10%.

E.W.Kellermann

537.59 : 523.75

275

SOLAR FLARE CONNECTED WITH AN INCREASE OF INTENSITY OF COSMIC RAYS.

ivsky, J.Hladký,, P.Mokrý, P.Chaloupka and T.Kowalski.

o Cimento, Vol. 15, No. 4, 695-6 (Feb. 16, 1960).

The details of a rather small solar flare (recorded near Prague) of an observed increase in cosmic-ray intensity are given. A elation of the increase with rapid changes of the magnetic field ng the development of the solar flare and filament is suggested.

C.F.Barnaby

537.59 : 523.74

276

SOLAR DISTURBANCES AND THE COSMIC RAY EQUATOR.

Pomerantz, A.E.Sandström, V.R.Potnis and D.C.Rose.

s, Vol. 12, No. 2, 231-5 (May, 1960).

The location of the cosmic-ray equator off the west coast of a has been established from measurements obtained with a board neutron monitor which made ten crossings between mber 1956 and October 1958. From the individual determina- of the point of minimum cosmic-ray intensity, the mean geo- hical position was 6.7 ± 0.8° N at 14° W. Direct measurements ero magnetic inclination were made at the same time in the ediate vicinity of this point. Although solar and geophysical ity varied considerably during this period, the location of the ic-ray equator appears to have remained fixed within approxi- ly 1°. However, the possibility of a small progressive change out the magnitude of the uncertainty cannot be precluded. Com- son of the results with plots of measurements of the magnetic ents along the ship's route reveals a significant difference een the location of the points of maximum horizontal intensity minimum cosmic-ray intensity.

537.59 : 523.75

277

COSMIC RAYS FROM THE SUN.

A.N.Charakhch'yan, V.F.Tulinov and T.N.Charakhch'yan.

eksper. teor. Fiz., Vol. 39, No. 2(8), 249-56 (Aug., 1960). In sian.

A number of large cosmic-ray flares were observed in the tosphere at a geomagnetic latitude of 64°. The flares are due 00-200 MeV protons. These intensity bursts were preceded by r chromosphere flares which are the source of the protons of indicated energies. It is suggested that these protons are ried by solar corpuscular beams with magnetic fields frozen de them.

537.59

20278

PROPAGATION OF LOW ENERGY COSMIC RAY PARTICLES ASSOCIATED WITH SOLAR FLARES.

Sakurai.

Geomagn. Geoelect., Vol. 11, No. 4, 152-64 (1960).

It has been observed that low energy cosmic rays are produced sociated with solar flares and propagate into interplanetary space. e features of the propagation mechanism were examined taking into count results deduced from the theory of the geomagnetic effect low energy cosmic rays. It is concluded that their incidence to e earth are manifest in impact zone effects, G.M.T. effects, and asonal variations. The relations between these low energy cosmic y events and solar and terrestrial phenomena were examined d it was observed that both flares and type IV outbursts taking ace on the western side of the sun were correlated with these smic ray events. A reasonable explanation of the propagation echanism of these low energy cosmic rays into interplanetary ace is proposed and in addition the properties of magnetic clouds that space are deduced.

537.59

20279

BACKSCATTER OF COSMIC RAYS BY THE SUN'S H II SPHERE.

G.A.Newkirk, J.W.Warwick and H.Zirin.

J. geophys. Res., Vol. 65, No. 8, 2540-2 (Aug., 1960).

The field-free cavity model suggested by Meyer, Parker and Simpson (Abstr. 2387 of 1957) is discussed in some detail and it is shown that the model can be deduced by consideration of the sun's H II sphere.

C.F.Barnaby

537.59 : 523.16

20280

COSMIC-RAY STORMS AND SOLAR RADIO OUTBURSTS.

Y.Kamiya and M.Wada.

Rep. Ionosphere Space Res. Japan, Vol. 13, No. 2, 105-11 (June, 1959).

Relations between the type of solar radio burst, cosmic-ray storm and magnetic storm were studied using the data obtained during I.G.Y. and the following results were obtained. 1. Almost all cosmic-ray storms are associated with Type IV solar radio outbursts. 2. The other types of outbursts are not related to cosmic-ray storms. 3. The size of a cosmic-ray storm is independent of the meridian distance of the radio outburst, but that of a magnetic storm depends on it. From these results, it can be concluded that a large corpuscular cloud with magnetic field is emitted simultaneously with Type IV solar radio burst occurrence and it has a small core which is the cause of the magnetic storm.

537.59

20281

THE COSMIC RADIATION DURING THE INTERNATIONAL GEOPHYSICAL YEAR.

R.Steinmaurer.

Acta phys. Austriaca, Vol. 13, No. 2-3, 224-30 (1960). In German.

Public lecture which includes a report of measurements at the Hafelekar laboratory, Innsbruck, by neutron monitor, ionization chamber, and counter telescope containing 10 cm Pb. Graphs are given of the cosmic-ray intensity in July, 1959, of the averages per sun rotation between 1936 and 1959, and of the variation of the diurnal maximum of the cosmic radiation between 1932 and 1959.

E.W.Kellermann

537.59

20282

INTENSITY MINIMUM IN COSMIC-RAY NEUTRONS DURING THE INTERNATIONAL GEOPHYSICAL YEAR.

M.Kodama and M.Wada.

J. geophys. Res., Vol. 65, No. 7, 2203-5 (July, 1960).

The data from nine stations for the period July 1957 to Dec. 1958 are analysed. The minimum intensity occurred about Jan. 1958, and the recovery was faster and more complete for lower latitudes. Long term and transient variations are considered.

E.J.Burge

537.59

20283

PRELIMINARY REPORT ON COSMIC RAY INTENSITY DURING MAGNETIC STORMS IN JULY 1959.

J.G.Roederer, O.R.Santochi, J.C.Anderson, J.M.Cardoso and J.R.Manzano.

Nuovo Cimento, Vol. 18, No. 1, 120-30 (Oct. 1, 1960).

The cosmic-ray intensity variation during three magnetic storms of July 1959 is analysed. Data from neutron monitors at Mina Aguilar (4000 m o.s.l. at 12°S geomagnetic latitude), Buenos Aires (0 m o.s.l., 23°S) and Ellsworth (0 m o.s.l., 67°S) were used. A method is described which gives detailed information on the variation of the primary cosmic-ray spectrum during magnetic storms. This method is applied to the present case, giving the following results; the shape of the primary variation spectrum responsible for the three July storms was approximately the same as that of the May 1959 storm. During the recovery of the second storm, an injection of considerable intensity of low energy particles was found. The time dependence of this extra flux is determined. During the slow recovery after the last storm, the primary variation spectrum changes its shape in a similar way as in the May storm recover. The correlation of these effects with geomagnetic activity is shown.

537.59

20284

ANALYSIS OF COSMIC RAY INTENSITY TIME-DEPENDENCE RECORDED AT MINA AGUILAR DURING JULY 1959.

J.G.Roederer, O.R.Santochi, J.C.Andersor J.M.Cardoso and J.R.Manzano.

Nuovo Cimento, Vol. 18, No. 1, 131-5 (Oct. 1, 1960).

Intensity variations of the nucleonic component at Mina Aguilar (4000 m o.s.l., 12°S geomagnetic latitude) are analysed as a function of time, for the July 1959 storms. It is suggested that the intensity behaviour is due to a linear addition of three independent Forbush decreases of different amplitudes and relaxation times, but of approximately the same form of primary variation spectrum at high energies. The slow recovery after the third storm is mainly determined by the relaxation time of the second storm.

537.59

20285 COSMIC RAY INTENSITY VARIATIONS DURING THE MAGNETIC STORM IN MAY 1959.

J.R.Manzano, J.G.Roederer and O.R.Santochi.
Nuovo Cimento, Vol. 18, No. 1, 136-46 (Oct. 1, 1960).

Cosmic-ray intensity during the May 1959 magnetic storm is analysed, using neutron monitor and cubic telescope data from Mina Aguilar, Buenos Aires, Ushuaia and Ellsworth (Antarctica). The primary variation spectrum is estimated according to a method outlined in the preceding abstracts. The intensity behaviour during recovery is analysed in detail. The following results were obtained. The primary variation spectrum, acting until the 18th May, has an approximate form given by $\delta D/D = \delta k(t) \cdot E^{-0.5}$, valid up to very high energies. Around the 18th this spectrum changes its shape at low energies (<2 GeV), in a similar way as it occurred during the July 1959 storm recovery. This change may be interpreted as an additional removal of low energy particles, which lasted at least until the end of the month. On May 14, intensity variation is quite peculiar, in spite of this being a quiet day from the solar and geomagnetic point of view. A world-wide decrease occurs, with a superposed, 10 hr increase, which is particularly high at Ellsworth (9% in the neutron monitor, 2% for the cubical telescope). It is shown that Ellsworth was located in a 04 impact zone for a simultaneous solar event. On the 24th, a world-wide, small Forbush decrease occurred, associated with a magnetic storm and a decrease in the horizontal component of the magnetic field. This Forbush decrease, which shows a strong longitude dependence, corresponds to a primary variation spectrum which has the same shape as that responsible for the general recovery acting at the time, i.e., after the low energy change on the 18th.

537.59

20286 THE SUDDEN INCREASE IN COSMIC RAY INTENSITY OF MAY 4, 1960. D.C.Rose.

Canad. J.Phys., Vol. 38, No. 9, 1224-7 (Sept., 1960).

Compares the data recorded at four stations, each equipped with a telescope and a standard neutron monitor. The geomagnetic latitudes, longitudes and altitudes in metres of the stations are; Resolute, 82.9°, 289.3°, 17m; Churchill 68.7°, 322.7°, 39m; Sulphur Mountain 52.9°, 300.4°, 2283m; Ottawa 56.8°, 351.4°, 101m. There are significant differences between the records of the four stations which are commented upon. The relative heights of the nucleon and meson components are consistent at the different stations.

E.W.Kellermann

537.59

20287 COSMIC RAY INTENSITY INCREASE ON MAY 4, 1960.

O.R.Santochi, J.R.Manzano and J.G.Roederer.
Nuovo Cimento, Vol. 17, No. 1, 119-21 (July 1, 1960).

Refers to a sudden big increase of about 110% in the quarter-hourly neutron counting rate in the interval 10.30 to 10.45 U.T. at Ellsworth, geomagnetic coordinates latitude 67° S, longitude 14.7° E, the station being located in the 09 impact zone for solar events occurring at 10.30. It is believed that there is an indication for a small absorption length of the additional flux. Monitors at Mina Aguilar (geomagnetic latitude 11.6°S, longitude 3.1°E) and at Buenos Aires (geomagnetic latitude 23.3°S, longitude 9.4°E) did not show abnormal behaviour on this day. E.W.Kellermann

537.59

20288 COSMIC RAY EVENT OF MAY 4, 1960.

J.Hladký, J.Kleczek, L.Křivský and P.Mokrý.
Nuovo Cimento, Vol. 17, No. 4, 610 (Aug. 16, 1960).

Reports an increase of the nucleonic component recorded by a neutron monitor at Prague (geomagnetic coordinates: 50° 00' N, 97° 13' E; 228 m above sea level), beginning at (10.33 ± 3)U.T., reaching a maximum of (11 ± 3)% at 10.50 U.T., and decaying to normal level as $t^{-3/2}$ during the following two hours. No increase is observed in meson or total intensity. A connection of the event with a loop prominence is suggested. E.W.Kellermann

53

20289 DEPENDENCE ON LATITUDE OF THE AMPLITUDE THE DIURNAL VARIATION OF COSMIC RAYS.

A.E.Sandström, E.Dyring and S.Lindgren.
Nature (London), Vol. 187, 1099 (Sept. 24, 1960).

In this preliminary report results are given which clearly sh that the amplitude of the diurnal variation of cosmic rays decrea with increasing angle between the asymptotic direction of the primaries and the equatorial plane of the Earth. It is suggested past results that appear to contradict this can be explained by the difficulty in resolving the radiation cones of the primaries.

C.F.Barn

537.5

20290 THE SOLAR DIURNAL VARIATION OF THE INTENSITY OF THE NUCLEONIC COMPONENT OF THE COSMIC RADIATION. P.L.Marsden and Q.N.Begum.

Phil. Mag. (Eighth Ser.), Vol. 4, 1247-54 (Nov., 1959).

The diurnal variation of the intensity of the nucleonic compo nent of the cosmic radiation detected at Leeds University Physic Laboratory through the period 1954-58 has been analysed. The results, together with previously reported neutron data, show tha the direction of the anisotropy causing the diurnal variation has remained substantially constant at 60-70° east of the line joining the earth to the sun except during 1954 when the direction change abruptly to become west of the earth-sun line. The amplitude of the diurnal wave shows considerable variation, closer in correla tion with the planetary amplitude of magnetic activity A_p, than wi relative sunspot numbers.

537

20291 THE DIURNAL VARIATION OF COSMIC RADIATION. W.Messerschmidt.

Z. Naturforsch., Vol. 15a, No. 8, 734-6 (Aug., 1960). In German.

The fluxes of cosmic-ray neutrons recorded at 32 stations du the International Geophysical Year are analysed for their diurnal variation. For this purpose, the stations are grouped according t latitude. For the period July 1957 to June 1958, the mean hourly intensities are averaged; they show a maximum between twelve a fifteen hours local time whose amplitude decreases with latitude. The mean amplitude of the diurnal variation is calculated for each month of the twelve month period and shows a maximum in Septen 1957. The neutron data are compared with the author's observati carried out between 1956 and 1959 with ion chambers above groun and below 14 m.w.e. of earth. The amplitude variation of the neut flux is similar to that found below ground, showing that the diurna variation extends to the more energetic radiation observed there.

E.G.Michae

537

20292 THE APPARENT SIDEREAL DAILY VARIATION OF COSMIC RAY INTENSITY DURING THE RECENT SUNSPOT MINIMUM. S.P.Baliga and T.Thambyahpillai.

Phil. Mag. (Eighth Ser.), Vol. 4, 973-84 (Aug., 1959).

The unusually large changes of phase which occurred in the cosmic-ray solar daily variation during the year 1954 were found by Conforto and Simpson (1957) to simulate strong sidereal daily variations. These authors have suggested that their results repr sent a genuine sidereal effect which is observable only during pe of extremely low solar activity as in 1954. A systematic search sidereal effects during this year was made using the results from Carnegie Institution stations as well as Colombo, Hobart and Tok Although no significant sidereal effects were seen at Colombo, the other data show substantial sidereal daily variations with a rema able consistency in phase. The time of maximum at the equator 19 hr L.Sid.T. while at higher latitudes it was about 22 hr L.Sid.T The character of the solar diurnal variations and the relations between their seasonal changes and sidereal daily variations are discussed and it is concluded that at least a part of the observed sidereal effects were spurious.

53

20293 THE VARIATION WITH TIME OF THE FLUX AND ENERGY SPECTRUM OF PRIMARY COSMIC-RAY ALPHA-PARTICLES. P.J.Duke.

Phil. Mag. (Eighth Ser.), Vol. 5, 1151-9 (Nov., 1960).

The total flux and energy spectrum of primary cosmic-ray alpha-particles at the top of the atmosphere were measured in emulsion stacks flown during September 1956 and June 1958. Va

± 26 and 130 ± 15 particles m^{-2} $sterad^{-1}$ sec^{-1} respectively obtained for the total flux. This reduction in the flux during 1958 was caused by the partial removal of those alpha-particles energies between 100 and 2000 MeV/nucleon. These changes correlated with the 11-year cycle of solar activity.

537 59

294 SLOW-NEUTRON INTENSITY AT HIGH BALLOON ALTITUDES.

R.C.Haymes and S.A.Korff.

. Rev., Vol. 120, No. 4, 1460-2 (Nov. 15, 1960).

n order to extend measurements of cosmic-ray neutrons to top on altitudes, a flight was conducted on Aug 24, 1959, in which tem of identical counters filled with enriched and natural $B^{10}F_3$ ised. An altitude of 122 000 ft at a geomagnetic latitude of 55°N attained, corresponding to 4-mb pressure; which is considerably r than previous measurements. The counting rate dropped to 1% of the maximum rate, which occurs at 60 000 ft. If one polates this curve to the top of the atmosphere, one obtains an r bound for the slow-neutron albedo of 0.03 neutron per cm^2-sec. background due to highly ionizing events in the counters increased nentially to about 63 000 ft, with a derived mean free path of g/cm^2. The background continued an exponential increase up to 000 ft, but with a mean free path of 15 g/cm^2.

537.59

95 RAPID REDUCTION OF COSMIC-RADIATION INTENSITY MEASURED IN INTERPLANETARY CE.

C.Y.Fan, P.Meyer and J.A.Simpson.

s. Rev. Letters, Vol. 5, No. 6, 269-71 (Sept. 15, 1960).

Evidence is presented, obtained from a counter telescope ied in the space probe Pioneer V and from simultaneous rdings of a neutron monitor situated at Climax, Colorado, veen March 1 and April 3, 1960, that there is no association of rapid decreases of galactic cosmic-ray intensity with the earth its magnetic field, but that the decreases are phenomena of r origin. Some of the properties of these modulating magnetic ds are deduced. E.W.Kellermann

537.59

0296 EXPERIMENTS ON THE ELEVEN-YEAR CHANGES OF COSMIC-RAY INTENSITY USING A SPACE PROBE.

Fan, P.Meyer and J.A.Simpson.

s. Rev. Letters, Vol. 5, No. 6, 272-4 (Sept. 15, 1960).

The experiments described consisted of carrying cosmic ray ctors measuring protons > 75 MeV to great distances in interetary space near the time of solar maximum. It is concluded the smallness of the gradient of cosmic ray intensity near the h orbit suggests that modulation of galactic intensity occurs at ances much greater than the orbit, and that any mechanism aging the cosmic ray intensity over 11 years is centred about sun with a scale size > 1 astronomical unit. E.W.Kellermann

537.59

0297 TIME-VARIATIONS OF THE MESONIC COMPONENT OF COSMIC RADIATION.

A.Nassef and M.El-Sherbini.

c. Math. Phys. Soc. Egypt, No. 22, 109-20 (June, 1958).

Investigations of the sea-level intensity variations of the onic component of cosmic radiations at Alexandria (geographic ude 31° 12 N, and longitude 29° 53′ E) were carried out from 1954 to June 1955. The observations were performed by apply- a 3-fold counter telescope of high angular resolution, oriented enith angle of 58° 48′ in the north direction. Another indentical scope was oriented in the south direction at the same zenith e. Both telescopes included a 10 cm lead filter. The telescopes e carefully protected from side-showers and knock-on electrons set of guard counters connected in anticoincidence and in 4-fold cidence with the telescope counters.

537.59

0298 COSMIC RAYS OBSERVED BY SATELLITE 1958 ALPHA.

Y.Aono and K.Kawakami.

. Ionosphere Res. Japan, Vol. 12, No. 1, 28-36 (March, 1958).

Signals telemetered on 108.03 Mc/s were received at Kokubunji recorded on magnetic tape, which was analysed by a sonagraph. analysis gives the numbers of cosmic rays counted by a Geiger nter in the satellite. The results show a definite tendency for the nber of cosmic rays to increase with altitude. An extreme rease of cosmic rays was observed at the beginning of the great gnetic storm on February 11, 1958. Diurnal variation of the mic rays might be found in early evening at an altitude of a few dred kilometres.

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20299 ALTITUDE DEPENDENCE AND TIME VARIATION OF THE RADIATION INTENSITY OBSERVED BY U.S. SATELLITE 1958α.

Y.Miyazaki and H.Takeuchi.

Rep. Ionosphere Res. Japan, Vol. 12, No. 4, 448-58 (1958).

Signals (cosmic ray data) telemetered from the U.S. satellite 1958α passing near Japan were analysed. The results are: (1) As the altitude increased from 340 to 1200 km, the counting rate of a single G.M. counter mounted in the satellite showed a gradual rise and then a steep rise followed at altitudes above 1200 km. The altitude curve also showed appreciable day-to-day variation which masked the latitude dependence of the intensity between 12° to 24° geomagnetic latitude. (2) The altitude curve seemed to show a comparatively wide hump at about 350 to 800 km. (3) Dividing the data into a certain narrow range of latitude and altitude, the counting rate increased gradually day by day from 1 to 10 February, 1958. Finally, it reached a value which was twice the earlier one. The planetary magnetic index Kp was also increasing during this period, but its fine variation did not always correspond to that of the counting rate. The variation of the radiation intensity at higher altitude seemed to have an appreciable longer time constant than that of the geomagnetic fluctuation. (4) On 11 February, the enhancement of the radiation intensity was observed at the altitude of about 1000 km. The time of onset was inferred to be between 0640 and 0842 U.T. The neutron intensity of cosmic rays observed at sea level or at mountain altitude showed an increase in the neighbourhood of 0700 U.T.

537.59

20300 COSMIC-RAY OBSERVATION BY KAPPA-VI ROCKET.

Y.Miyazaki and H.Takeuchi.

Rep. Ionosphere Res. Japan, Vol. 12, No. 4, 475-7 (1958).

Reports measurements by G—M counters, mounted in rocket heads, of counting rates as functions of time of flight and of altitude up to about 50 km. E.W.Kellermann

537.59

20301 SECULAR VARIATION OF COSMIC-RAY LATITUDE EFFECT.

S.Fukushima and M.Kodama.

Rep. Ionosphere Space Res. Japan, Vol. 13, No. 2, 112-19 (June, 1959).

Two latitude surveys for cosmic rays at sea level were carried out along the same route in different years. Solar activities corresponding to the respective periods in which the surveys were performed, do not show such a remarkable difference. Nevertheless cosmic rays revealed some variations for primary energy spectrum. It has been suggested from the change in spectrum that there may exist a hysteresis effect in cosmic rays against solar activity.

537.59

20302 COSMIC RAYS AT SEA LEVEL AND THE EARTH'S MAGNETIC FIELD.

M.Kodama.

Sci. Pap. Inst. Phys. Chem. Res.(Tokyo), Vol. 54, 20-42 (March, 1960).

Measurements of cosmic-ray nucleon and meson components were carried out along a sea level course between Japan and the Antarctic twice in 1956-7 and in 1958-59. The following results were obtained from these latitude surveys. (1) The cosmic-ray equator at 107°E geographic longitude is situated at 5°S geomagnetic latitude, which coincides with the geomagnetic dip equator measured simultaneously. (2) The position of the latitude knee at about 20°E geographic longitude in the southern hemisphere is much lower than the ordinary one and corresponds to 6.4 BV for the cut-off rigidity, calculated for the eccentric dipole model of the earth's magnetic field. (3) Comparison of results of the two surveys shows that rigidity spectrum changed in the 6-8 BV region of the cut-off rigidity. Using the above results, together with the results of other latitude surveys, world-wide distribution of cosmic-ray neutron intensity at sea level is determined. From a comparison of the world map thus obtained with various models for the earth's magnetic field, it is concluded that this world-wide distribution can be explained by the geomagnetic field, including the non-dipole parts.

537.59

20303 RESULTS OF CONTINUOUS RECORDINGS OF COSMIC RAYS WITH IONIZATION CHAMBERS AT HALLE (φ = 51.5° N, λ = 12° E).

W.Messerschmidt.

Z. Naturforsch., Vol. 15a, No. 5-6, 470-84 (May-June, 1960).

In German.

These have been obtained by four chambers shielded by 140 g cm^{-2} at geomagnetic co-ordinates 51.5° N, 97° E, 100 m above sea-level. Two chambers were placed in the laboratory, another in a shaft 10 m deep and 3 m wide, and the fourth chamber at the same depth under 14 m water equivalent. Results are given of the observed barometer effects, of the influence of magnetic storms, and of time variations. The 27-day variation is observed by the two first chambers only. The author lists a sidereal effect of 1.5‰ amplitude at 21 hr sidereal time as indicated by the third chamber.

E.W.Kellermann

537.59

20304 THE CRITICAL B-VALUES IN THE GEOMAGNETIC EFFECT OF COSMIC RAYS. K.Sakurai.

J. Geomagn. Geoelect., Vol. 11, No. 1, 34-6 (1959).

The minimum momenta with which cosmic-ray particles can arrive at a geomagnetic latitude have been calculated, assuming that the critical value of B, the angular momentum of the particle at infinity from the magnetic dipole, is varying from 2.00 at 0° to 0.14 at 80° geomagnetic latitude.

E.W.Kellermann

537.59

20305 ON THE DERIVATION OF COSMIC RAY SPECIFIC YIELD FUNCTIONS.

W.R.Webber and J.J.Quenby.

Phil. Mag. (Eighth Ser.), Vol. 4, 654-64 (May, 1959).

A series of revised differential response curves and yield functions have been deduced for the nucleonic and ionizing components of the secondary cosmic radiation at various atmospheric depths, using the most recent data on the primary spectrum and on geomagnetic cut-off rigidities.

537.59 : 539.17

20306 DOUBLE MAXIMUM ANGULAR DISTRIBUTIONS IN HIGH ENERGY NUCLEAR COLLISIONS.

J.Gierula, M.Mięsowicz and P.Zieliński.

Nuovo Cimento, Vol. 18, No. 1, 102-19 (Oct. 1, 1960).

A detailed statistical analysis of the shape of the angular distribution of secondary particles generated in 65 nuclear collisions for primary energies higher than 10^{12} eV is presented. The double maximum shape of the distribution (in coordinate log tg θ) is a general feature of the events with high degree of anisotropy of secondaries in c.m. system. It is found that the shape of the angular distribution is in agreement with the predictions of the two-centre model of multiple meson production both for nucleon—nucleon and nucleon—heavy nucleus collision. A new parameter D, which is a measure of the deviation from the normal shape of the distribution towards the two centre distribution and also a coordinate convenient for visualizing this deviation, are introduced.

537.59

20307 HIGH ENERGY NUCLEAR INTERACTIONS OF HEAVY COSMIC RAY PRIMARIES.

E.Balea, E.Friedländer, M.Oncescu, C.Potoceanu and M.Sahini.

Rev. de Physique (Bucarest), Vol. 5, No. 1, 91-8 (1960).

These interactions have been examined in a stack of 600 μ plates from the 1953 Sardinian expedition. Jets induced by primary nuclei of charge Z ≥ 2 and of estimated average energy per nucleon of 50-100 GeV show frequently a two-cone structure which is interpreted by means of the two centre model. It is believed that the existence of two such centres is not consistent with their interpretation as excited nucleons. The fragmentation of the incident nucleons is not believed to be restricted to evaporation processes.

E.W.Kellermann

NUCLEUS

539.14 : 539.12

A HISTORY OF NEUTRONS AND NUCLEI. See Abstr. 20144

539.14

20308 HOLE—HOLE INTERACTIONS AND THE PROPERTIES OF NUCLEAR MATTER.

S.A.Moszkowski and A.M.Sessler.

Nuclear Phys., Vol. 18, No. 4, 669-71 (Sept. (2), 1960).

The contribution of hole—hole interaction to the ground-state energy of nuclear matter is estimated for a mutual interaction containing a repulsive core and an exponential well outside, and is found to be only about ½ MeV per particle.

539.14 : 539.

NUCLEAR FORCES AND THE PROPERTIES OF NUCLEAR MATTER. See Abstr. 20083

539.

20309 VARIATIONAL CALCULATIONS WITH REPULSIVE CORE POTENTIALS. N.Austern and P.Iano.

Nuclear Phys., Vol. 18, No. 4, 672-80 (Sept. (2), 1960).

A variational method is described which is suitable for fairly detailed calculations with repulsive core potentials. The method employs a wave-function which goes over to an exact solution of t two-body Schrödinger equation whenever two nucleons are closer together than a certain distance b. The ideas of effective range theory suggest that the results should not be sensitive to the energ parameter which characterizes the exact solution, a suggestion which is seen to be valid to great accuracy in a numerical calcula tion with a simple but characteristic potential. The new method i compared with straightforward variational approaches to the sam problem, as well as with variational procedures based on a cutoff potential, and is found superior to them both. A practical application of the new method in calculating the Li^6 structure is also cite

539

20310 NUCLEAR COLLECTIVE MOTION AND THE EFFECT TWO-BODY POTENTIAL. Y.Shono and H.Tanaka.

Progr. theor Phys., Vol. 22, No. 2, 177-91 (Aug., 1959).

An effective two-body interaction is uniquely determined, on t condition that the interaction causes a nucleus to deform. The int action consists of two terms. One is Elliott's Q—Q interaction [Proceedings of the Pittsburh Conference on Nuclear Structure (19 298] and the other a restoring term. It is shown that the interacti causes nuclear rotational levels and the moment of inertia is abou $I_{rig}/3$ in the case of typical nuclear defomation. The formalism i the dynamical Hartree method and all results are derived in two-c mensional space.

539.14 : 539.

20311 TENSOR FORCE OF THE PION-THEORETICAL POTENTIAL AND THE DOUBLET SPLITTING IN n—He^4 SCATTERING.

S.Nagata, T.Sasakawa, T.Sawada and R.Tamagaki.

Progr. theor. Phys., Vol. 22, No. 2, 274-98 (Aug., 1959).

In order to investigate whether the spin—orbit force in the theory of nuclear shell structure is due to the tensor force of the pion-theoretical potential, the doublet splitting of the p-phase shifts in low-energy n—He^4 scattering is analysed. It is concluded that the major part of the experimental doublet splitting can be reproduced by the strong tensor force of the pion-theoretical potential are important to the binding energy of He^4 ar the discontinuity of the binding energies between He^4 and the syst of He^4 plus one nucleon.

539.

20312 NOTE ON THE SPIN—ORBIT COUPLING AND TENSO FORCES. S.Takagi, W.Watari and M.Yasuno.

Progr. theor. Phys., Vol. 22, No. 4, 549-65 (Oct., 1959).

The spin—orbit coupling in heavy nuclei is investigated on the basis of strong tensor interaction between nucleons, characteristi of the pion theory of nuclear forces. It is shown that the process which includes the exchange of the incident nucleon with those of t target nucleus deformed by itself is important in the low-energy region, and that this process provides the spin—orbit coupling wit a correct sign and reasonable magnitude.

539.

20313 SPIN—ORBIT COUPLING AND TENSOR FORCES. B.Jancovici.

Progr. theor. Phys., Vol. 22, No. 4, 585-94 (Oct., 1959).

A possible explanation of the spin—orbit coupling in heavy nuclei, by second-order effects of the tensor forces is investigate The various second-order terms are described by four graphs, in the case of one particle outside closed shells. The main contribution comes from an exclusion effect: two particles of the closed shells cannot, by mutual excitation, jump into the orbit which is already occupied by the outside particle. This effect could accoun at least partially, for the observed spin—orbit splitting. The case a hole is also investigated, and shows the same kind of agreement A comparison is made with other work.

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314

ON THE ROLES OF EFFECTIVE INTERACTIONS IN NUCLEAR COLLECTIVE MOTION.

da, M.Kobayasi, T.Marumori, T.Shiozaki and S.Takagi.
. theor. Phys., Vol. 22, No. 5, 663-80 (Nov., 1959).

n attempt to investigate nuclear collective motion from the
point of particle excitations is outlined. In this method it is
ble to investigate the roles of the effective inter-particle
actions in nuclear collective motions and clarify the mechanism
collective excitation. The fundamental idea is illustrated by
the simplified two dimensional harmonic oscillator shell
l with the quadrupole—quadrupole effective interactions
en particles. It is shown that this system successfully
ibes both the surface vibrational and the rotational collective
ons consistently, depending upon the assumed configurations of
cles in the shells.

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0315

COMPARISON OF THE THEORY OF NON-AXIAL NUCLEI WITH EXPERIMENTS.

Grigoriev and M.P.Avotina.
ear Phys., Vol. 19, No. 3, 248-63 (Oct. (3), 1960).

Experimental data on the energy levels and relative γ-transi-
probabilities are compared with the theory of non-axial nuclei.
shown that within the limits of applicability of the theory none
e data contradict it. In a number of cases it yields a better
anation of the experimental data than the generalized Bohr—
elson model.

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0316

NUCLEAR MODELS.

R.J.Eden.

gress in nuclear physics, Vol. 6 (London: Pergamon Press,
) p. 26-51.

The object of this survey paper is to describe the main features
ifferent nuclear models and to consider how far each model can
egarded as contributing to an integrated picture of the nucleus.
ics dealt with include the shell model and its extensions;
ective motion and the rotational model; general remarks on
ear models at low energies; the compound nucleus model; the
istical model; the optical model; models for high-energy nuclear
tions; and a brief account of the many-body theory of the
eus.

J.B.Birks

539.14

20317

EXTENSION OF THE SHELL MODEL FOR HEAVY SPHERICAL NUCLEI. M.Baranger.

s. Rev., Vol. 120, No. 3, 957-68 (Nov. 1, 1960).

The Bardeen—Bogoliubov—Belyaev treatment of the pairing cor-
tions is applied to spherical nuclei with a general nuclear force.
interaction between quasi-particles is treated by the method of
arized equations of motion. An advantage of this treatment is
the same equations describe single-particle excitations and
ective excitations, so that the former are orthogonal to the latter
the total number of states is correct. Another advantage is that the
rious states due to the fluctuations in the number of particles are
omatically eliminated. The equations to be solved resemble those
a two-body shell-model calculation. Simple estimates, based on
a-function or quadrupole forces, are made for the vibrational
quencies in various modes and transition matrix elements. It is
cluded that the method is as powerful as other known methods for
ling with collective states by the shell model, and that the same
er of magnitude for the effective nuclear force seems capable of
ing all the data.

539.14

20318

NUCLEAR DEFORMATION IN THE SPHEROIDAL SHELL MODEL. K.Lee and D.R.Inglis.

s. Rev., Vol. 120, No. 4, 1298-1302 (Nov. 15, 1960).

In the usual shell-model procedure, the effective Hamiltonian
tains only half the sum of the shell-model potentials of nucleons
rder to avoid counting average pairwise interactions twice.
ause of the factor one-half, the nondiagonal elements of this
niltonian in the harmonic oscillator representation do not vanish,
they have been neglected in previous calculations of nuclear
ormations by Nilsson and others, in which one minimizes total
ll-model energy at constant volume. Here it is shown in typical
es (without taking spin—orbit coupling into account) that the
ilibrium deformation is unaltered in second and third order and
t the fourth-order modification arising from the nondiagonal
ments is very small. The relation of these nondiagonal elements
to those of the pairwise interactions is also discussed.

539.14

20319

COLLECTIVE VIBRATIONS IN P^{31}.

V.K.Thankappan and S.P.Pandya.

Nuclear Phys., Vol. 19, No. 3, 303-8 (Oct. (3), 1960).

An attempt was made to explain the energy levels and the electromagnetic transitions in P^{31} in terms of the collective vibrational model. The results were found to be fairly satisfactory.

539.14

20320

EQUILIBRIUM DEFORMATION OF Ra^{226}.

I.Dutt and P.Mukherjee.

Progr. theor. Phys., Vol. 22, No. 6, 814-18 (Dec., 1959).

The Hamiltonian of a single particle moving in a pear-shaped potential is discussed. In order to investigate the effect of spin-orbit coupling in a field of octupole deformation a simpler radial form is suggested. A Nilsson's representation is chosen and eigenvalues are calculated using second-order perturbation. It is shown that in order to explain the occurrenceof the 253 keV (1—) level in Ra^{226}, the octupole deformation parameter a_3 takes the value 0.02.

539.14

20321

THE MASSES OF THE LIGHT NUCLEI.

J.Mattauch.

Nuovo Cimento Suppl., Vol 6, No. 1, 254-73 (1957). In German.

Reviews the present status of measurements of the masses of the light nuclides and discusses the agreement between Q-values, binding energies, etc., obtained by various methods.

R.H.Thomas

539.14 : 539.18

RELATIVE NUCLIDIC MASSES. See Abstr. 20570

539.14

20322

APPROXIMATE CALCULATION OF NUCLEAR BINDING ENERGY. L.S.Rodberg and V.L.Teplitz.

Phys. Rev., Vol. 120, No. 3, 969-77 (Nov. 1, 1960).

The binding energy, size, and shape of finite nuclei are studied using a method which tests the "local uniformity" assumption. This assumption implies that the properties of finite nuclei can be obtained from those of infinite nuclear matter. The energy is computed using as a trial wave-function an amplitude- and frequency-modulated plane wave; this permits the use of nuclear-matter results in a straightforward manner. The calculation gives a binding energy which is too low, a radius which is too small, and a nuclear surface which is too diffuse. Several possible corrections to this result are examined.

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20323

PAIRING ENERGY FOR DEFORMED NUCLEI.

M.Nomoto.

Progr. theor. Phys., Vol. 22, No. 5, 597-609 (Nov., 1959).

An attempt is made to estimate the pairing energy for strongly deformed nuclei by dividing the energy into two parts, one of which is the interaction energy between the nucleons forming the last pair, while the other part arises from the deformation of the nucleus. Assuming an attractive inter-nucleon force with a short range, the interaction energy in the last pair is first estimated on the Nilsson model [K. Danske Vidensk. Selsk. mat.-fys. Medd., Vol. 29, No. 16 (1955)] and is then estimated in the case where the deformation is extremely strong. The other part is estimated on the unified model. The calculation is carried out for the last neutron pairs of the five nuclei Gd^{158}, Dy^{164}, Yb^{174}, Hf^{178} and Hf^{180} in the rare-earth region. The results obtained by using the Nilsson model as well as the unified model are in fairly good agreement with the experimental data.

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20324

NUCLEAR MOMENTS AND SPINS.

K.F.Smith.

Progress in nuclear physics, Vol. 6 (London: Pergamon Press, 1957) p. 52-107.

This comprehensive review describes the experimental methods of measuring nuclear spins and moments, and indicates the manner the results have been accounted for theoretically. An initial section is devoted to a statement of the main theoretical results required to understand the experimental techniques. The methods used for determining moments and spins of nuclear ground states include optical hyperfine structure, optical double resonance, band spectra, molecular beam deflection, molecular beam magnetic resonance, radio-frequency spectroscopy and microwave spectroscopy. A 7-page table is given of the spins, magnetic dipole moments and electric quadrupole moments of nuclear ground states for Z = 0 – 84, 89 and 91 – 95. Methods of determining the spins, parities and moments of nuclear excited states are also described. There are 229 references. J.B.Birks

539.14

20325 jj COUPLING MODEL IN ODD–ODD NUCLEI.

M.H.Brennan and A.M.Bernstein.

Phys. Rev., Vol. 120, No. 3, 927-33 (Nov. 1, 1960).

An analysis is made, using the jj-coupling model, of the spins of 76 low-lying levels of odd—odd nuclei with 20 < A < 120. Levels have been excluded from the analysis if any ambiguity exists in the assignment of a configuration. Excluding particle—hole configurations it is found that Nordheim's "strong" rule is obeyed in the 22 cases in which it is applicable. Nordheim's "weak" rule is replaced by a rule predicting a ground state of the highest or lowest allowable spin. This revised rule is obeyed in 38 out of 41 cases. This competition between two levels of greatly differing spin results in the frequent occurrence of isomerism. For particle—hole configurations the state of the highest spin minus one is the ground state in 6 out of 13 cases. This agreement with experiment is obtained using proton and neutron configurations which, in 66 of the 76 cases, are found as ground states in the neighbouring odd—even nuclei. The three revised coupling rules are predicted by the calculations of Schwartz, in which the residual proton—neutron interaction has a delta-function radial dependence, if the singlet-to-triplet strength is taken as 0.6, independent of mass number. This value is the same as that required to fit the free two-nucleon data. Exceptions to the empirical coupling rules and this theory are discussed.

539.14

20326 NUCLEAR ORIENTATION OF Mn^{54} AND Mn^{52m}.

R.W.Bauer, M.Deutsch, G.S.Mutchler and D.G.Simons.

Phys. Rev., Vol. 120, No. 3, 946-51 (Nov. 1, 1960).

The spins of the nuclides Mn^{54} (290 days) and Mn^{52m} (21 min), incorporated in the lattice of cerium magnesium nitrate and nickel fluosilicate crystals, have been oriented at low temperatures. The measurement of the angular distribution of the gamma rays from Mn^{54} indicate the spin of Mn^{54} to be 3 or 2; in the latter case, the beta decay must be predominantly of the Fermi type with an upper limit of 10% of a possible Gamow—Teller admixture. From a simultaneous measurement of the angular distribution of the gamma rays from Mn^{54} and 5.7 day Mn^{52} the ratio of the nuclear g-values of the two isotopes is found, which yields a magnetic moment for Mn^{54} of 2.55 ± 0.21 n.m. (for spin 3) or 2.16 ± 0.26 n.m. (for spin 2). The circular polarization measurements of the gamma rays from Mn^{54} determine this moment to be positive. Similar angular distribution experiments on Mn^{52m}, assuming spin 2, yield a magnetic moment of 1.04 ± 0.16 n.m. if the beta decay is predominantly a Gamow—Teller transition, or 0.72 ± 0.16 n.m. for a pure Fermi transition. These results indicate that the nuclear g-values of the 21 min and the 5.7 day states of Mn^{52} are about the same.

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20327 NUCLEAR SPINS OF SIX NEUTRON-DEFICIENT GOLD ISOTOPES.

W.B.Ewbank, L.L.Marino, W.A.Nierenberg, H.A.Shugart and H.B.Silsbee.

Phys. Rev., Vol. 120, No. 4, 1406-10 (Nov. 15, 1960).

The nuclear spins of six neutron-deficient isotopes of gold were measured by atomic-beam magnetic-resonance methods. The results of these measurements are as follows: Au^{191}(3.0 hr), $I = \frac{3}{2}$; Au^{192}(4.8 hr), I = 1; Au^{193}(17.5 hr), $I = \frac{3}{2}$; Au^{194}(39 hr), I = 1; Au^{195}(190 day), $I = \frac{3}{2}$; Au^{196}(5.6 day), I = 2.

539.14 : 539.18

20328 ATOMIC BEAM STUDY OF THE HYPERFINE STRUCTURE OF THULIUM-170.

A.Y.Cabezas and I.Lindgren.

Phys. Rev., Vol. 120, No. 3, 920-5 (Nov. 1, 1960).

The atomic-beam magnetic-resonance technique was used to measure atomic and nuclear quantities of the 129 day isotope Tm^{170} as follows: $J = \frac{7}{2}$, $g_J = 1.14122 \pm 0.00015$, I = 1, $|A| = 200 \pm 3$ Mc/s, and $|B| = 1010 \pm 15$ Mc/s. The values of J and g_J are consistent with the ground-state assignment $^2F_{7/2}$. Values of the nuclear moments are calculated from the hyperfine-structure interaction constants A and B by use of a two-parameter radial wave-function in which one parameter is determined from comparison with Hartr functions and the other parameters from the experimental spin—o coupling constant. Uncorrected values are obtained, as follows: $|\mu_I| = 0.26 \pm 0.02$ n.m. and $|Q| = 0.61 \pm 0.05$ barn, with the two moments of the same sign. The same wave-function is used to cal late the relativistic and diamagnetic corrections to the atomic g-value, and the result is in excellent agreement with the experim

539.14 : 539

20329 HYPERFINE STRUCTURE OF AMERICIUM-241.

R.Marrus, W.A.Nierenberg and J.Winocur.

Phys. Rev., Vol. 120, No. 4, 1429-35 (Nov. 15, 1960).

Atomic-beam measurements on Am^{241} confirm that the nuclea spin is I = 5/2, and establish that the electronic ground state is characterized by an angular momentum J = 7/2 and a Lande splittin factor $g_J = -1.9371(10)$ In addition, the magnetic-dipole and electric-quadrupole hyperfine-structure coupling constants were found to be, respectively, $A = \pm 17.144(8)$ Mc/s and $B = \mp 123.82(1$ Mc/s. It is hypothesized that these values arise from a state that is primarily formed from the Hund's rule term ^8S of the configuration $(5f)^7(7s)^2$. However, important contributions to the measured g_J, A, and B values are shown to come from the admixture of other terms in the ground state by means of the spin-orbit interaction, a also from the excitation of s electrons in the core to higher s state

539.14 : 539.

QUADRUPOLE MOMENTS OF DEFORMED NUCLEI WITH K = 1 AND $K = \frac{1}{2}$. See Abstr. 20401

539

20330 INTRINSIC QUADRUPOLE MOMENTS OF DEFORMED NUCLEI AND SUPERFLUIDITY IN NUCLEI.

N.K.Glendenning and J.Sawicki.

Nuclear Phys., Vol. 18, No. 4, 596-614 (Sept. (2), 1960).

Intrinsic quadrupole moments of deformed nuclei are calculat on a completely particle picture as a function of the atomic numbe Z and the parameter of spheroidal distortion of the well in which t independent particles move. The effects of the pairing force respo sible for the superfluid property on the existence of an energy gap are examined by using the Green's function method of Migdal (1959 The deformation of the single-particle potential well is treated (a) as a perturbation and (b) exactly, by using the Nilsson and Mottels Nilsson energy spectra and wave-functions. It is necessary to incl the configuration mixing with the major harmonic-oscillator shells N' = N ± 2 caused by the deformation. In order to account for the observed quadrupole moments, slightly smaller values of the Nilss deformation parameter are required than those following from the uniform-charge model. The effect of the energy gap is to smear o the shell-closure effects. As a result, the dependence of quadrupo moments on Z is similar to that predicted by the uniform-charge model.

539.1

20331 EVALUATIONS OF NUCLEAR QUADRUPOLE COUPLING INTEGRALS.

H.Narumi, T.Watanabe, O.Nakahara and Y.Kato.

Sci. Engng. Rev. Doshisha Univ., Vol. 1, No. 1, 173-89 (March, 196

In order to find a more accurate value for the electric quadru pole moment of the deuteron the field gradient $\langle \partial^2 V/\partial z^2 \rangle$ at the deuteron is evaluated using the James—Coolidge wave-function for the ground state of the HD molecule. The method of calculation is given and the coupling integrals obtained are tabulated. C.J.Bat

539.14 : 539.

20332 EVALUATIONS OF NUCLEAR QUADRUPOLE COUPLING INTEGRALS. II.

H.Narumi, T.Watanabe, Y.Kato and A.Saika.

Sci. Engng Rev. Doshisha Univ., Vol. 1, No. 2, 191-224 (Aug., 1960

The integrals $I_{\alpha\beta}^{(\gamma)}$, $J_{\alpha\beta}^{(\gamma)}$, $K_{\alpha\beta}^{(\gamma)}$ and $L_{\alpha\beta}^{(\gamma)}$ are evaluated in order to find the electric quadrupole moment of the deuteron.

539.14 : 539

20333 EVALUATION OF THE NUCLEAR QUADRUPOLE MOMENT OF N^{14}.

Y.Kato and O.Nakahara.

J. Phys. Soc. Japan, Vol. 14, No. 5, 690-1 (May, 1959).

This is calculated from the coupling of the quadrupole momen with the second derivative of the electrostatic potential in the NH_3 molecule, using previously calculated wave-functions which give agreement with the binding energy. The value obtained, × 10^{-26} cm^2, is intermediate between values previously obtained nsidering other molecules. E.J.Squires

539.14 : 539.2

BROADENING OF THE MÖSSBAUER LINE. See Abstr. 17882

539.14 : 530.12

ETHER DRIFT EXPERIMENT USING THE MÖSSBAUER IATION. See Abstr. 18918

539.14 : 530.12

ASSESSMENT OF EXPERIMENTAL TESTS OF THE "CLOCK ADOX" USING THE MÖSSBAUER EFFECT IN Fe^{57}. See r. 18917

539.14 : 539.2

ACOUSTICALLY MODULATED γ RAYS FROM Fe^{57}. See r. 17883

539.14 : 532.7 : 533.7 : 539.2 : 530.16

γ-RAY RESONANCE ABSORPTION BY AN ARBITRARY SYSTEM NTERACTING PARTICLES. See Abstr. 18992

539.14 : 539.2

NUCLEAR RESONANCE ABSORPTION IN Dy^{161} SITUATED IN O_3 AND DYSPROSIUM IRON GARNET. See Abstr. 17920

539.14

0334 COLLECTIVE EXCITATION OF NONAXIAL EVEN—EVEN NUCLEI. A.A.Chaban.

eksper. teor. Fiz., Vol. 38, No. 5, 1630-6 (1960). In Russian.

Collective-excitation states of nonaxial even—even nuclei are stigated allowing for interaction between rotational and ational states.

539.14

0335 THE INFLUENCE OF ULTRASONICS ON THE EMISSION AND ABSORPTION OF γ-RAYS WITHOUT RECOIL.

bragam.

. Acad. Sci. (Paris), Vol. 250, No. 26, 4334-6 (June 27, 1960). rench.

It is shown that the introduction of ultrasonics into a crystal taining γ-radioactive nuclei facilitates the frequency scanning of Mössbauer spectrum. E.A.Sanderson

539.14

0336 NATURAL WIDTH AND DOPPLER BROADENING IN THE ^{152}Sm 961 keV γ-RAY RESONANCE.

.Moon and B.S.Sood.

c. Roy. Soc. A, Vol. 257, 44-51 (Aug. 23, 1960).

By moving a $Eu_2^{152m}O_3$ source on the tips of a high-speed rotor, 961 keV emission spectrum was swept across the resonance line stationary Sm_2O_3 scatterer. The observed resonance/fluorescence intensity was compared with a curve calculated by taking into ount the Doppler effects due to electron capture and thermal tions but neglecting the effects of natural line widths. At negative or speeds, when the emission line scanned the low-energy wing he resonance line, the influence of the natural line width on the onance/fluorescence intensity was observed. At positive rotor eds there was a good agreement with the theoretical calculations; s shows that with a stationary source the thermal broadening is ninant in restoring the resonance whereas the line wing overlap negligible. See also following abstract.

539.14

20337 LIFETIME OF THE 961 keV 1^- LEVEL IN ^{152}Sm. G.G.Shute and B.S.Sood.

oc. Roy. Soc. A, Vol. 257, 52-8 (Aug. 23, 1960).

With a $Eu_2^{152m}O_3$ source and a Sm_2O_3 scatterer, nuclear γ-ray sonance scattering and resonance fluorescence self-absorption periments (see preceding abstract) were performed to determine lifetime of the 961 keV 1^- level in Sm^{152}. The value obtained om scattering, $(8 \pm 2) \times 10^{-14}$ sec, is larger than that determined om self absorption, $(4.7 \pm 0.5) \times 10^{-14}$ sec; this could be due to adequate knowledge about the slowing down of the source nuclei fore the emission of the γ-ray. From a comparison of these lues, a mean free path of 0.6 × 10^{-8} cm for the source nucleus coiling after electron capture in $Eu_2^{152}O_3$ was calculated.

539.14

20338 THE INFLUENCE OF THE EFFECT OF COLLISIONS OF RECOIL NUCLEI ON THE RESONANCE SCATTERING CROSS-SECTION OF γ-RAYS BY THE NUCLEUS Ni^{60}. D.K.Kaipov and Yu.K.Shubnyi.

Zh. eksper. teor. Fiz., Vol. 39, No. 3(9), 888-9 (Sept., 1960). In Russian.

The resonance scattering of γ-rays with energy 1330 keV by Ni^{60} in gaseous and liquid sources is investigated. With a liquid source the cross-section is found to be $(1.73 \pm 0.2) \times 10^{-27}$ cm^2 and the lifetime of the level to be $(1.14 \pm 0.37) \times 10^{-12}$ sec. Using this information and previously determined values for the corresponding quantities for a gaseous source, the path length of nuclear recoil is calculated to be 8 × 10^{-8} cm. E.A.Sanderson

539.14

20339 ISOTOPE SHIFT AND FERMI—SEGRÈ FORMULA. N.J.Ionesco-Pallas.

Progr. theor. Phys., Vol. 21, No. 4, 655-7 (April, 1959).

It is shown that the formulae for the isotope shift which are obtained by the methods of Broch (1945) and of Sommerfeld (1941) coincide with each other only if the Fermi—Segrè formula is correct. J.Hawgood

539.14

20340 SPIN—ORBIT SPLITTING AND TENSOR FORCE. T.Terasawa.

Progr. theor. Phys., Vol. 22, No. 1, 150-2 (July, 1959).

Using the one-meson exchange potential or the Serber potential, the P-state doublet splittings in He^5 and N^{15} are calculated in second-order perturbation theory. Whereas earlier authors obtained too small a value or one of the wrong sign, the present calculation gives the right sign and order of magnitude. This is primarily due to a careful consideration of the Pauli principle for low-lying intermediate states. See also following abstract. P.K.Kabir

539.14

20341 NOTE ON THE SPIN—ORBIT COUPLING AND THE TENSOR FORCES. S.Takagi, W.Watari and M.Yasumo.

Progr. theor. Phys., Vol. 22, No. 1, 154-6 (July, 1959).

The "target exchange" term in the effective potential exerted by a nucleus on an additional nucleon is estimated, assuming only tensor forces and no spin—orbit forces between individual nucleons. It is shown that this may yield the correct spin—orbit coupling, both in sign and order of magnitude. See also preceding abstract. P.K.Kabir

539.14

20342 CALCULATION OF SPLITTING OF $3s_{1/2}$ NEUTRON LEVELS. F.C.Barker.

Nuclear Phys., Vol. 19, No. 1, 110-12 (Sept. (3), 1960).

A simple calculation of the separation of the levels produced by addition of a $3s_{1/2}$ neutron to an odd-proton nucleus gives satisfactory agreement with the observed separation.

539.14

20343 ON THE STATISTICAL PROPERTIES OF THE LEVEL-SPACINGS IN NUCLEAR SPECTRA. M.L.Mehta.

Nuclear Phys., Vol. 18, No. 3, 395-419 (Sept. (1), 1960).

The level-spacing distribution is studied under the random-matrix hypothesis. Rigorous lower and upper bounds for the distribution function of the level-spacing are given. Comparison of these with Wigner's surmise shows that it is a very good approximation. It is shown, however, that it cannot be exact even in the limiting case n → ∞. See also following abstract.

539.14

20344 ON THE DENSITY OF EIGENVALUES OF A RANDOM MATRIX. M.L.Mehta and M.Gaudin.

Nuclear Phys., Vol. 18, No. 3, 420-7 (Sept. (1), 1960).

An exact expression for the density of eigenvalues of a random-matrix is derived. When the order of the matrix becomes infinite, it can be seen very directly that it goes over to Wigner's "semicircle law". See also preceding abstract.

539.14

20345 ABSOLUTE PRECISION MEASUREMENTS OF NUCLEAR ENERGY LEVELS AND THEIR BREADTHS IN TERMS OF FUNDAMENTAL ATOMIC CONSTANTS. H.H.Staub.

Nuovo Cimento Suppl., Vol. 6, No. 1, 306-14 (1957).

A method is described of measuring the absolute energy and widths of resonances in γ-ray producing reactions induced by protons. The protons from an electrostatic generator pass to a magnetic spectrometer consisting of a circular magnet sector of about 200° with a mean radius of 50 cm. The magnetic field along the orbit varies by less than 1 part in 10 000 about its average. The entrance and exit slits are mounted in the uniform field. The field is stabilized and measured in terms of a nuclear resonance frequency. The potential of the target to be bombarded can be varied so that measurements over a narrow resonance can be carried out with a fixed magnetic field. A NaI scintillation counter was used to detect the γ-rays. Correction of measured resonance widths are necessary for (a) proton energy spread due to the finite resolution of the spectrometer, (b) time fluctuation of the magnetic field, and (c) Doppler effect of target nuclei. The following results have been obtained:

Reaction	Resonance energy (keV)	Width (keV)
$Li^7(p,\gamma)$	441.2 ± 0.6	12 ± 1
$F^{19}(p,\alpha\gamma)$	340.5 ± 0.3	3.3 ± 0.2
$F^{19}(p,\alpha\gamma)$	871.3 ± 0.4	4.5 ± 0.2
$Al^{27}(p,\gamma)$	990.8 ± 0.2	0.06 ± 0.03

R.E.Meads

539.14

20346 REDUCED WIDTHS OF INDIVIDUAL NUCLEAR ENERGY LEVELS. A.M.Lane.

Rev. mod. Phys., Vol. 32, No. 3, 519-66 (July, 1960).

A study is made of the reduced widths of individual nuclear energy levels. This is contrary to the usual statistical interpretation. Expressions for the individual widths are derived from the shell model and the strong coupling version of the Bohr–Mottelson model. These predictions are compared with the experimental data, which is presented in some detail for $A \leq 40$. A.M.Green

539.14 : 539.16

POSSIBLE VIBRATIONAL LEVELS IN AN ODD-MASS NUCLEUS. See Abstr. 20388

539.14

20347 LOW LEVELS OF Al^{27}.

E.Almqvist, D.A.Bromley, H.E.Gove and A.E.Litherland.

Nuclear Phys., Vol. 19, No. 1, 1-17 (Sept. (3), 1960).

The de-excitation radiation from the 0.84 and 1.013 MeV levels in Al^{27} was studied at a number of resonances in the reaction $Al^{27}(p, p'\gamma)$ with proton energies between 1.7 MeV and 2.8 MeV. The data supported assignments $\frac{1}{2}+$ and $\frac{3}{2}+$ to the 0.84 and 1.013 MeV states. The 1.013 MeV state was observed to be de-excited, 2.4 (±0.3)% via a 0.170 MeV transition to the 0.84 MeV level and remainder to the ground state. It was found that either one or both of these radiations had an E2/M1 amplitude ratio $\gtrsim 0.2$. These results and other properties of the low levels of Al^{27} were discussed in terms of the rotational collective model which was found to give a good qualitative description of most of the known data.

539.14 : 539.17

Be^8 LEVELS. See Abstr. 20444

539.14 : 539.17

C^{11} LEVELS AND THEIR SPINS. See Abstr. 20455

539.14

20348 THE 9.63 MeV STATE OF C^{12}.

F.C.Barker, E.Bradford and L.J.Tassie.

Nuclear Phys., Vol. 19, No. 1, 101-9 (Sept. (3), 1960).

An analysis of the data from experiments involving the 9.63 MeV state of C^{12} suggests that this state may be 3^-, and not 1^- as previously supposed. An experiment to distinguish between these possibilities is suggested.

539.14 : 539.16

ENERGY LEVELS OF F^{18}, Na^{22} AND Ne^{22} NUCLEI. See Abstr. 20414

539

20349 LEVELS OF N^{15} NEAR 7 MeV EXCITATION FROM $N^{14}(d,p')N^{15*}$. J.L.Honsaker.

Astrophys. J., Vol. 132, No. 2, 516-17 (Sept., 1960).

The $N^{14}(d,p)N^{15}$ protons were studied carefully studied in the energy region corresponding to excitation of N^{15} near to 7 MeV. In previous investigations this region was obscured by the presen of oxygen contamination groups. No new energy levels were foun near 7 MeV excitation of N^{15}. The astrophysical significance of t result is pointed out. L.L.Gr

539.14 : 539

20350 NUCLEAR ENERGY LEVELS OF N^{17}, O^{18}, AND O^{20}. N.Jarmie and M.G.Silbert.

Phys. Rev., Vol. 120, No. 3, 914-19 (Nov. 1, 1960).

The reactions $O^{18}(t,\alpha)N^{17}$, $O^{18}(t,p)O^{18}$ and $O^{18}(t,p)O^{20}$ were stu with a 180°, double-focusing magnetic spectrometer. The measur energy levels of N^{17} up to 4.3 MeV are at 1.374, 1.851, 1.906, 2.53 3.132, 3.212, 3.652 and 4.010 MeV. The measured energy levels O^{18} up to 5.2 MeV are at 3.560, 3.639, 3.925, 4.457 and 5.084 MeV The measured energy levels of O^{20} up to 4.6 MeV are at 1.682, 4. and 4.449 MeV. Standard deviations of 15 to 25 keV were assigne to these excitation energies. The Q value for $O^{18}(t,\alpha)N^{17}$ was dete mined to be 3.872 ± 0.015 MeV, which leads to a mass for N^{17} of 17.013 856 ± 0.000 017 a.m.u. The Q value for $O^{18}(t,p)O^{20}$ was dete mined to be 3.086 ± 0.015 MeV, which leads to a mass for O^{20} of 20.010 430 ± 0.000 017 a.m.u. Reaction cross-sections at 30° lab. angle and 2.6 MeV triton energy are presented for each level.

539.14 : 539.

20351 ENERGY LEVELS OF Ne^{21} AND Ne^{23}. J.M.Freeman.

Phys. Rev., Vol. 120, No. 4, 1436-41 (Nov. 15, 1960).

The energies of 27 excited states of Ne^{21} and 17 of Ne^{23} were established by a study of the (d,p) reactions in Ne^{20} and in Ne^{22}. Seven deuteron bombarding energies between 4.75 and 7.5 MeV we used, and the target was a cell with thin windows, containing eithe natural or Ne^{22}-enriched neon gas. The proton groups emitted at were analysed with a broad-range magnetic spectrograph. The established calibration of the spectrograph, in terms of alpha part from polonium, together with some well-known reactions, provide the data necessary for precise energy determinations. The Q valu obtained for the ground-state reactions $Ne^{20}(d,p)Ne^{21}$ and $Ne^{22}(d,p)$ were 4.534 ± 0.009 and 2.791 ± 0.009 MeV, respectively. Deutero groups inelastically scattered from Ne^{20} and Ne^{22} were also obser The higher energy groups were used in the calibration procedure; the lower energy groups gave the results 4.250 ± 0.008 and 3.356 ± 0.008 MeV for the second excited states of Ne^{20} and Ne^{22}, respectively. The interpretation of the level schemes of Ne^{21} in terms of the collective model has been considered and is discusse here briefly.

539

20352 ISOTOPIC SPIN SELECTION RULES. XIII. THE 6.92 MeV STATE OF ^{16}O REVISITED.

R.E.Pixley, J.V.Kane and D.H.Wilkinson.

Phil. Mag. (Eighth Ser.), Vol. 5, 359-64 (April, 1960).

For Pt XII, see Abstr. 5557 of 1957. The status of the possib E1-E3 cascade between the 2+ state at 6.92 MeV, the 3− state at 6.14 MeV and the 0+ ground state of O^{16} is reviewed in the light o recent improvements in the knowledge of radiative transitions an isotopic spin impurities. It is concluded that the present limit of 5×10^{-3} on the relative intensity, although clearly demonstrating the efficacy of the isotopic spin selection rule, is not sharp enoug to be a significant test for detailed models of the nuclear structur for which purpose an improvement by an order of magnitude woul be required. It is shown by a coincidence method, using the react $F^{19}(p,\alpha)O^{16}$, that the relative intensity is less than 4×10^{-4}. This corresponds to $\alpha_0^2(1) < 2 \times 10^{-3}$, a low figure.

539

20353 ISOTOPIC SPIN SELECTION RULES. XIV. TRANSIT BETWEEN MIRROR STATES IN ^{13}C AND ^{13}N.

J.V.Kane, R.E.Pixley and D.H.Wilkinson.

Phil. Mag. (Eighth Ser.), Vol. 5, 365-72 (April, 1960).

The 3.68 MeV 3/2− state of C^{13} is shown, by a coincidence technique to cascade via the 3.09 MeV 1/2+ state with a probabili of $(6.5 \pm 1.0) \times 10^{-3}$. The rule that corresponding E1 transitions mirror nuclei have the same reduced speed, i.e. are mirror trans d to deduce the speed of this weak branch from data available in .d hence to determine the radiative width of the M1 transition to from the 3.68 MeV state. This is (0.40-0.75) eV. The speed of ansition, which is not a mirror transition to the corresponding N^{13}, is compared with the prediction of the independent particle . Agreement is obtained within the range of the intermediate ng parameter a/K that satisfies other data in the A = 13 system.

539.14 : 539.16

354 REDUCED WIDTHS IN O^{16} AND GAMMA-TRANSITION PROBABILITIES IN F^{19}. B.Roth and K.Wildermuth.

ar Phys., Vol. 20, No. 1, 10-14 (Oct. (2), 1960).

educed widths in O^{16} and γ-transition probabilities in F^{19}, atively predicted by the cluster model, are compared with imental data.

539.14

355 DETERMINATION OF THE SPINS OF Pt^{196} NUCLEAR LEVELS USING γ-RAYS EMITTED IN THE CAPTURE RESONANCE NEUTRONS.

.Galanina, B.F.Shvartzman and A.Ya.Diament.

eksper. teor. Fiz., Vol. 38, No. 5, 1446-50 (1960). In Russian.

Gamma-rays produced on capture of resonance neutrons were stigated. From the ground transition in the γ-ray spectrum, spin of the compound nucleus levels was determined. It was d that the spin is 1 for Pt^{196} levels with neutron energies of and 68.2 eV and 0 for a level energy of 19.6 eV.

539.14

0356 NUCLEAR TRANSITIONS OF RADON NUCLEI. R.Foucher.

. Acad. Sci.(Paris), Vol. 250, No. 26, 4346-8 (June 27, 1960). rench.

Discusses experimental data which suggest that radon nuclei are her spherical nor of the type that possess a permanent axial rmation as suggested by Bohr and Mottelson. R.H.Thomas

539.14 : 539.16

LOWER EXCITED STATES OF W^{185}. See Abstr. 20418

539.14

0357 ENERGY LEVELS AND CONFIGURATION INTERACTION IN Zr^{90} AND RELATED NUCLEI.

lmi and I.Unna.

lear Phys., Vol. 19, No. 3, 225-42 (Oct. (3), 1960).

Proton and neutron $p_{\frac{1}{2}}$ and $g_{\frac{9}{2}}$ configurations (and in particular interaction of the two 0^+ states in Zr^{90}) are considered without specific assumptions on the two-body nuclear interaction and ial functions. Matrix elements of the effective nuclear interon are determined by the analysis of energy levels in Zr^{90} and eral neighbouring nuclei (e.g. Sr^{86} which has the same configuras). Good agreement is obtained between calculated and experintal level spacings. The one non-diagonal matrix element is ermined along with the diagonal elements and the amount of adture is calculated in all cases. The ground state of Zr^{90} is nd to be 75% in the $p_{\frac{1}{2}}^2$ configuration and 25% in the $g_{\frac{9}{2}}^2$ conration in agreement with the rough experimental findings. The iority is found to be a good quantum number for the effective raction obtained in the $g_{\frac{9}{2}}$ shell of identical nucleons. This interion gives rise to the low lying $\frac{7}{2}+$ level in Sr^{85}. Level schemes dicted by the present calculation are given for several nuclei.

539.14

20358 AN EXAMPLE OF THE REACTION: $K^- + {}^{12}C \rightarrow {}^9Be_\Lambda + \pi^- + {}^3He$ AND THE SUBSEQUENT DECAY IN FLIGHT THE ^9Be HYPERFRAGMENT. M.Taher-Zadeh.

ovo Cimento, Vol. 17, No. 6, 980-2 (Sept. 16, 1960).

Describes a completely analysable example of a rare mode of cay of the ${}_\Lambda Be^9$ hypernucleus initiated by a K^- meson absorbed a carbon nucleus in nuclear emulsion. S.J.St-Lorant

539.14

20359 A NON-MESONIC DECAY OF A ${}^{11}_{\Lambda}B$ HYPERFRAGMENT. D.Evans, B.D.Jones and J.Zakrzewski.

l. Mag. (Eighth Ser.), Vol. 4, 1255-9 (Nov., 1959).

An event is described which is interpreted as the non-mesonic cay of ${}_\Lambda B^{11}$ into Li^8, a deuteron and a proton. Any other interetation is seen to have a negligible probability of being correct e binding energy of the Λ^0-hyperon in the ${}_\Lambda B^{11}$ hypernucleus is nd to be 11.3 ± 0.8 MeV.

539.14

20360 π^--MESON DECAYS OF THE H^3_Λ HYPERFRAGMENT. V.A.Lyul'ka.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 78-9 (July, 1960). In Russian.

The ratio of the lifetimes of the decays $H^3_\Lambda \rightarrow He^3 + \pi^-$ and $H^3_\Lambda \rightarrow d + p + \pi^-$ is considered in the impulse approximation, taking into account the interaction in the proton–deuteron system. It is shown that for a spin $j = \frac{1}{2}$ of the hypernucleus H^3_Λ, the value of this ratio is in good agreement with the experimental value.

539.14

20361 ENERGY AND ANGULAR DISTRIBUTIONS IN HYPERNUCLEAR DECAYS. V.A.Lyul'ka.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 471-5 (Aug., 1960). In Russian.

The energy and angular distributions for the ${}_\Lambda He^4 \rightarrow He^3 + p + \pi^-$ decay are computed in the momentum approximation. It is demonstrated that if the interaction in the proton–He^3 system is taken into account, satisfactory agreement with the experimental data is obtained. The energy distribution of π^--mesons from the decay ${}_\Lambda H^3 \rightarrow d + p + \pi^-$ is also considered.

RADIOACTIVITY . NUCLEAR DECAY

539.16

20362 FRACTIONATION OF NUCLEAR WEAPON DEBRIS. C.S.Cook, R.L.Mather, R.F.Johnson and F.M.Tomnovec.

Nature (London, Vol. 187, 1100-1 (Sept. 24, 1960).

Reports the discovery of large particles (0.3-1 mm dia.) in the fall-out from nuclear explosions falling into two groups. These two groups are characterized by the marked presence or absence of Zn^{90} and Nb^{90} isotopes. R.H.Thomas

539.16

20363 AN APPARATUS FOR THE RAPID RECORDING OF DISTRIBUTED RADIATION.

K.H.Lauterjung and W.Gruhle.

Nuclear Instrum. and Methods, Vol. 5, No. 5, 323-6 (Nov., 1959). In German.

There are two possibilities for recording the distribution of radiation intensity in an extended area. The first has good space resolution, but requires a recording time too long for rapid changes, while the second records with good resolution of time but with a restricted one of space. The new method has a good resolution both of time and of space. The main feature is the use of the propagation speed of GM-counter discharge. The area under inspection is covered by ten counters, each of which is sensitive for 1 msec or 10 msec. The primary pulse of radiation hitting the sensitive counter starts the recording device and the arrival of the discharge in a short probe counter triggers a c.r.o. display which maps the radiation.

539.16

20364 RADIOACTIVE LABELLING OF MEMBRANE FILTERS FOR THE ASSAY OF AIR-BORNE MATERIAL.

G.Kubie and K.Spurný.

Nature (London), Vol. 187, 930-1 (Sept. 10, 1960).

Describes work done on the incorporation of radioactive material into membrane filters to assay the quantity of airborne material collected in them. Filters labelled with nickel and thallium were used to assay flue dust by measuring the absorption of the β-rays produced by the accumulated solid material in the filter. The lower limits of sensitivity were found to 1.6 mg cm^{-2} and 6.0 mg cm^{-2} in the use of nickel and thallium respectively. R.H.Thomas

539.16

20365 CALCULATION OF THE DOSE RATE OF A HOLLOW CYLINDRICAL SOURCE. T.Kaminishi.

Rep. Govt. Industr. Res. Inst., Nagoya, Vol. 9, No. 3, 132-40 (March. 1960). In Japanese.

Methods of calculation are given based on the line source model which is resolved by the use of the Secant Integral Function. Some approximate formulae for the calculation of Secant Integral Function and its curves in the region of k = 0.1 to 1.0 are given.

On each of two Co^{60} sources, the dose rate at the centre and the dosage distribution on the central axis and the radius direction were calculated. Some simplified methods were also used for rough estimation of the dose rate, and the errors were corrected approximately for higher accuracy. These results agreed very well with the observed values. The source shapes are also discussed.

539.16

20366 DETERMINATION OF DOSE RATES FROM BETA TRANSMISSION CURRENTS. A.Bradley.

J. appl. Phys., Vol. 31, No. 10, 1826 (Oct., 1960).

The calculation of absorbed dose rates from experimental measurements of beta transmission currents can be simplified by using the approximation that beta absorption is an exponential function of sample thickness. The dose rate in rads is $R = \mu I_\beta E_{av}/10a$ where μ = mass absorption coefficient (cm^2/g), I_β = beta transmission current (μA), E_{av} = average beta energy (MeV), a = area of sample irradiated (cm^2). Because of the approximately reciprocal relationship between μ and E_{av} the dose rate function of the beta transmission current is nearly independent of the isotope.

C.F.Barnaby

539.16

20367 RADIATION DOSIMETRY USING PLASTIC MATERIALS. I. M.Le Fort and X.Tarrago.

Internat. J. appl. Radiation and Isotopes, Vol. 7, No. 4, 323-6 (Feb., 1960). In French.

The radiation induced absorption at 3000 A in Plexiglas is used for measuring radiation doses at each point in a volume irradiated by six 130 curie radiocobalt sources. The results obtained for a cylindrical volume, 9 cm in diameter and 20 cm in height, are given. The doses measured were in the region of 10^5 rads/hour. Results are given on the uniformity of the dose in this volume. It is shown that the method is very suitable for measuring doses of 10^5 rads and above.

C.F.Barnaby

539.16 : 539.1.07

A WAVELENGTH-INDEPENDENT RECORDING DOSIMETER FILM. See Abstr. 19978

539.16

20368 INSTALLATION OF AN IRRIATION ARRANGEMENT FOR ONE KILOCURIE OF RADIOCOBALT.

M.Lefort, X.Tarrago and M.Viaux.

J. Phys. Radium, Vol. 19, Suppl. No. 4, 61A-64A (April, 1958). In French.

Design of a kilocurie Co^{60} gamma ray source is described. Irradiation facilities are given both for research on radiation chemistry and photonuclear reactions. Cobalt samples were placed in six small cylinders in a lead drum. Dose-rates are indicated for various exposure chambers. The volume of the central exposure chamber is of 1 litre and the integral dose rate is of 2×10^8 rad. kg hr^{-1}. Tubes or electrical leads connected to external apparatus can easily be introduced with the sample.

539.16 : 537.52

20369 EFFICIENT TRITIUM LABELING WITH AN ELECTRIC DISCHARGE. F.L.Jackson, G.W.Kittinger and F.P.Krause.

Nucleonics, Vol. 18, No. 8, 102-5 (Aug., 1960).

Discharge tubes are described in which the preparation of tagged organic compounds is accelerated by the use of a Tesla coil. Purification and purity tests are described.

R.D.Smith

539.16 : 535.8

RADIOACTIVITY OF OPTICAL INSTRUMENTS WITH COMPOUNDS OF POTASSIUM BROMIDE. See Abstr. 19409

539.16

20370 THE DETERMINATION OF RADIOACTIVE DECAY CONSTANTS. F.Brown and G.R.Hall.

Nuovo Cimento Suppl., Vol. 6, No. 1, 283-93 (1957).

Reviews the main methods of determining the decay constants of radioactive nuclides with half-lives between a few seconds and several years. Among the techniques discussed include the use of balanced ionization chambers, automatic electroscopes, mass spectrometers, gravimetric analysis, α-particle pulse height analysis and absolute β-particle counters.

R.H.Thomas

539

20371 PROPOSITION FOR A NEW METHOD FOR MEASURI SHORT HALF-LIVES. B.Johansson and T.Alväger.

Nuclear Instrum., Vol. 3, No. 1, 49-51 (July, 1958).

A new method is described by which it may prove possible to measure half lives of isomeric states as short as 10^{-14} sec. Supp a source emits two K-conversion electrons separated by a short time interval to be measured. Energy selection and focusing of th first electron is achieved magnetically and it then passes between condenser plates to which an r.f. field is applied. A slit following the deflector plates allows the electron to reach a detector if it passes the plates at zero phase. The second electron, after magn focusing, is passed between similar plates to which the same r.f. field is applied. Because of the delay, a non-zero deflection will be obtained, and the electron will be counted in a second detector if its corresponding slit is in the correct position. The half-life could be determined by measuring the coincidence counting rate as a function of the position of the second slit relative to the zero phase position. Conditions for obtaining optimum resolution of thi device are discussed.

R.E.Mea

539.

20372 ISOMERS OF Am^{242}.

F.Asaro, I.Perlman, J.O.Rasmussen and S.G.Thompso

Phys. Rev., Vol. 120, No. 3, 934-43 (Nov. 1, 1960).

New measurements on the Am^{242} isomers show that the 16 hr activity is the ground state and the 152 yr activity the upper isome contrary to earlier evidence. By electrostatic collection techniqu some 16 hr americium activity was separated from an aged sampl containing the 152 yr isomer. Careful study of the conversion electron spectrum of the sample containing 152 yr Am^{242m} revealed ele conversion lines of a 48.6 keV transition converted in americium, and the relative M subshell conversion intensities are only consist with an E4 assignment. This information, coupled with the recent atomic beam measurement of spin 1 for the 16 hr activity, leads to spin assignment of 5 for Am^{242m}. The experimental information on these isomers is given a detailed analysis in terms of the Bohr—Mottelson model. The most surprising conclusion of this analysis is that the spin 1 ground state has a K-quantum number of zero, an hence a negative spectroscopic quadrupole moment. Data on levels and decay of the low spin isomers of Ho^{166} and Ta^{180} are also considered and lead to the conclusion that there is generally an energy displacement, between odd and even spin members, of K = 0 rotational bands in odd—odd spheroidal nuclei.

539.1

20373 THEORY OF α-DECAY OF NONSPHERICAL NUCLEI.

V.G.Nosov.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 141-8 (July, 1960). In Russian.

A consistent theory is developed which is based on the corresponding generalization of the quasi-classical quantum mechanical approximation. Formulae are derived for the relative intensities the α-ray fine structure lines and also for the α-decay constant an the angular distribution of α-particles emitted by oriented nuclei. A new method is proposed for measurement of quadrupole polarization of oriented nuclei.

539.

20374 [PRECISE] MEASUREMENT OF THE ENERGY OF α-PARTICLES FROM SOME EMITTERS.

A.A.Vorob'ev, A.P.Komar and V.A.Korol'ev.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 70-2 (July, 1960). In Russian.

The emissions from At^{217}, Fr^{221}, Po^{213}, U^{235} and U^{238} were investigated with an ionization α-spectrometer.

539.1

20375 NONLOCAL POTENTIAL AND ALPHA-DECAY BARRIER PENETRABILITY. M.L.Chaudhury.

Phys. Rev. Letters, Vol. 5, No. 5, 205-6 (Sept. 1, 1960).

An expression is given for the alpha-decay barrier penetrabili factor for the case of a potential barrier which consists of the usu Coulomb term and also a short-range velocity dependent term. Th latter is introduced as a nonlocal interaction kernel. It is found th the penetrability factor can have nearly double that value obtained with the corresponding static potential.

A.M.Gr

539.

20376 ENERGIES OF ALPHA-PARTICLES.

A.H.Wapstra.

Nuclear Phys., Vol. 18, No. 4, 587-95 (Sept. (2), 1960).

Energies of alpha-particles emitted in ground-state transitions een nuclei with mass < 200 were computed from experimental obtained with magnetic spectrometers using the newest ration results.

539.16

0377 α[-RAY] FINE STRUCTURE OF Bi^{210} (RaE).

R.J.Walen and G.Bastin-Scoffier.

J. hys. Radium, Vol. 20, No. 6, 589-93 (June, 1959). In French.

The α-ray structure of Ra E was determined by means of magnetic trography. Two groups were observed with following energy and dance: 4.686 MeV, 0.5×10^{-6} and 4.649 MeV, 0.75×10^{-6}. The lts are discussed in terms of possible structure of Tl^{206} and .

539.16 : 539.17

0378 COMPARISON OF Po^{210} ALPHA-PARTICLE ENERGY WITH THE $Li^7(p,n)Be^7$ REACTION THRESHOLD ENERGY.

Browne, J.A.Galey, J.R.Erskine and K.L.Warsh.

. Rev., Vol. 120, No. 3, 905-13 (Nov. 1, 1960).

Recent absolute measurements of the Po^{210} alpha-particle energy gree with the older value used as the standard for many nuclear tion energy measurements. A new comparison with the ,n)Be^7 reaction threshold energy was made using the Notre Dame trostatic accelerator and broad-range spectrograph. Four separ- methods of comparison were used. In the first three the thresh- was run and then protons or deuterons were scattered from opriate targets so that the scattered group was recorded on spectrograph plate near the alpha group from a source placed e target position. First, the spectrograph and, second, the n analyser were used to compare particle momenta. Third, with fields held constant after the threshold was run with the molec- beam, deuterons were scattered, giving particles of the same as the alphas. In the fourth method several reaction energies are precisely known in terms of the $Li^7(p,n)Be^7$ reaction threshold rgy were measured in terms of the Po^{210} alpha-particle energy. se were the $Mg^{24}(d,d')Mg^{24*}$ reaction to the first excited state of and the $N^{14}(d,p)N^{15}$ reaction leading to three excited states of . The four measurements agree and give 5.3086 ± 0.003 MeV for alpha-particle energy based on 1.8811 MeV for the $Li^7(p,n)Be^7$ ction threshold energy.

539.16

20379 INVESTIGATION OF α-DECAY OF U^{236}.

A.P.Komar, G.A.Korolyov and G.E.Kocharov.

. eksper. teor. Fiz., Vol. 38, No. 5, 1436-8 (1960). In Russian.

An ionization chamber with a grid was employed to investigate α-spectrum of U^{236}. After introduction of corrections to account ionization, imperfect grid shielding and rise time of the pulse, energy of the fundamental α-particle group was found to be 488 ± 0.003) MeV. The energies and intensities of transitions to 2^+ and 4^+ levels of the daughter nucleus were also determined.

539.16 : 537.56

COLLECTION OF IONS PRODUCED BY ALPHA PARTICLES AIR. See Abstr. 19612

539.16 : 537.56

IONIZATION BY POLONIUM ALPHA PARTICLES IN AIR. ee Abstr. 19613

539.16

20380 PSEUDOSCALAR INTERACTION IN NUCLEAR BETA DECAY.

C.P.Bhalla and M.E.Rose.

hys. Rev., Vol. 120, No. 4, 1415-24 (Nov. 15, 1960).

The experiments on the allowed beta transmissions, which lead lmost uniquely to the V-1.2 A interaction, do not have any bearing n a possible contribution from the pseudoscalar interaction. To etermine whether or not any contribution from the pseudoscalar nteraction is really needed, an examination has been made of the longitudinal polarization and the β shape factor in the 0 → 0(yes) beta ransitions. The theoretical polarization for the mixture of the seudoscalar and the axial vector interactions has been developed. n this work, the formulation of the pseudoscalar interaction as iven by Rose and Osborn has been used. The numerical results on he β longitudinal polarization and the shape factor depend on two arameters, namely, the coupling constant ratio, C_P/MC_A, and λ, he ratio of the two relevant nuclear matrix elements. M is the ucleon mass in units of the electron mass. The electronic functions ccurring in the theoretical formulae for these effects are tabulated for $Pr^{144}(0^- \rightarrow 0^+)$ and $Ho^{166}(0^- \rightarrow 0^+)$. All the electronic radial functions were computed considering the nucleus as a sphere of a uniform charge distribution with a nuclear radius as $1.2\,A^{1/3} \times 10^{-13}$ cm, and taking into account the finite de Broglie wavelength effect. The results of extensive numerical analysis are presented. It is concluded that the absence of the pseudoscalar interaction is consistent with the existing experimental data. The value of C_P/MC_A, which also gives a satisfactory fit to the experimental data depends on λ. The upper limit of the value of $|C_P/MC_A|$ is found to be 0.05 for $|\lambda| = 200$. In this work, time-reversal invariance is assumed valid for the weak as well as the strong interactions, and the two-component theory of the neutrino has been used.

539.16

20381 THE DECAY ENERGY OF Ba^{133}.

M.K.Ramaswamy, W.L.Skeel and P.S.Jastram.

Nuclear Phys., Vol. 19, No. 3, 299-302 (Oct. (3), 1960).

Reports the transition energy for the decay of Ba^{133} to Cs^{133} to be 489 keV, confirming Gupta's results, in disagreement with the estimate of 700 keV from beta-decay systematics. The log ft values for the orbital capture transitions to the 437 and 381 keV levels, as well as gamma cascade studies reported previously, supported a single-particle description for all of the low-lying levels of Cs^{133}, with the possible exception of the one at 158 keV. The doublet splitting between of $d_{3/2}$ and $d_{5/2}$ levels was found to be 300 keV. This splitting and the ground state quadrupole moment were not, however, in good agreement with estimates based on a pure single-particle configuration.

539.16

20382 MOTT-SCATTERING ANALYSIS OF LONGITUDINAL POLARIZATION OF ELECTRONS FROM Co^{60}.

J.S.Greenberg, D.P.Malone, R.L.Gluckstern and V.W.Hughes.

Phys. Rev., Vol. 120, No. 4, 1393-1405 (Nov. 15, 1960).

Mott scattering has been used to analyse the degree of longitudinal polarization of beta particles emitted from radioactive nuclei. The reliability of this method and the influences of the various systematic errors associated with this method on the accuracy of the measurement have been investigated in detail and are discussed. On the basis of a linear extrapolation of the inverse of the Mott asymmetry to zero scatterer thickness, the polarization of 194 keV electrons from Co^{60} was found to be $-(0.0995 \pm 0.057)v/c$ with all known corrections applied. The effects of atomic screening and finite nuclear size was not included. Using the quoted value for the polarization measured in the pure Gamow–Teller transition in Co^{60} yields $C_A' = (0.7 \text{ to } 1.45)C_A$.

539.16

20383 DECAY OF Er^{161}.

I.S.Dueprovskii, L.Németand L.K.Peker.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 13-15 (July, 1960). In Russian.

Studied with the aid of a scintillation spectrometer and a double focusing β-spectrometer. A decay scheme is proposed.

539.16

20384 ON THE MULTIPLE DECAY $Ge^{78} \xrightarrow{\beta^-} As^{78}$.

C.Ythier and A.H.W.Aten, Jr.

J. Phys. Radium, Vol. 20, No. 7, 694-6 (July, 1959). In French.

Ge^{78} produced by the reaction $Se^{82}(n, \alpha n)Ge^{78}$ with 30 MeV neutrons has been isolated by chemical means. Its half-life was determined by successive separations using different chemical procedures and was found to be 2.1 ± 0.1 hr, in disagreement with an early result of Sugarman (see Abstr. 2658 of 1953).

539.16

20385 A SHORT-LIVED HEAVY ISOTOPE OF LUTETIUM.

A.H.W.Aten, Jr and A.G.Funke-Klopper.

Physica, Vol, 26, No. 1, 79-80 (Jan., 1960).

Beta and gamma activity of the same period ($4\frac{1}{2} \pm 1$ min) were observed from the rare earth fraction precipitated after the irradiation of hafnium with fast neutrons. From the intensity of its activity, it is concluded that this is probably due to an isomer of a lutetium isotope of even mass. A.E.I. Research Laboratory

539.16

20386 STUDY OF THE ELECTRONS AND AUTOIONIZATION X-RAYS EMITTED SIMULTANEOUSLY WITH THE β-RAY FROM PROMETHIUM 147.

F.Suzor and G.Charpak.

J. Phys. Radium, Vol. 20, No. 6, 647-8 (June, 1959). In French.

With 2 proportional counters in coincidence, a study has been made of the low energy photon and electron spectra in Pm^{147}. The intensity of the autoionization L X-ray is found to be $(3.2 \pm 0.2)10^{-4}$. The electron spectrum emitted simultaneously with the β spectrum, in strong disagreement with theory, is found to reach 160×10^{-4} between 1 and 5 keV and 50×10^{-4} between 5 and 20 keV.

539.16

20387 POLARIZATION OF β-ELECTRONS FROM ORIENTED RaE.

K.Z.Dolginov and N.P.Popov.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1518-24 (1960). In Russian.

A formula was deduced for the polarization vector of electrons emitted in β-decay of a RaE nucleus whose spin was oriented in an external field. The region of possible nuclear matrix element values was determined on basis of experimental data on the shape of the spectrum and the longitudinal polarization of β-particles. These values were used to compute the polarization of β-particles from oriented RaE. The dependence of the polarization on the assumed nuclear radius was considered. It was found that the transverse polarization of β-particles was very sensitive to any possible nonconservation of time parity.

539.16 : 539.14

20388 THE W^{187} DECAY SCHEME AND POSSIBLE VIBRATIONAL LEVELS IN AN ODD-MASS NUCLEUS.

C.J.Gallagher, Jr, W.F.Edwards and G.Manning.

Nuclear Phys., Vol. 19, No. 1, 18-39 (Sept.(3), 1960).

The transitions and levels of Re^{187} populated by W^{187} β^--decay were investigated with a bent crystal spectrometer, an iron-free homogeneous-field spectrometer, an iron-free 180°-focusing spectrometer and a fast—slow coincidence angular-correlation unit. Seventeen transitions were observed, which were interpreted to establish 8 excited levels in Re^{187}. An analysis of the levels in terms of the Nilsson description showed that certain definite discrepancies exist between the theoretically expected level order and that observed. It was therefore suggested that two of the levels observed may correspond to the coupling of single particle states to gamma-vibrations.

539.16

20389 DISINTEGRATION OF Te^{119}.

C.W.Kocher, A.C.G.Mitchell, C.B.Creager and T.D.Nainan.

Phys. Rev., Vol. 120, No. 4, 1348-53 (Nov. 15, 1960).

The disintegration of Te^{119} was studied with the aid of magnetic spectrometers and scintillation counters. Two half-lives are observed — one of 4.7 ± 0.3 days and one of ~16 hr. These represent the decay from two isomeric states. The isomeric transition is not observed because of the strong competition from the decay to states of Sb^{119}. The 4.7-day disintegration occurs by electron capture and exhibits gamma rays of the following energies: 0.153, 0.270, 0.930, 1.10, 1.22 and 2.12 MeV. The following coincidences are observed: (2.12, 0.270), (1.22, 0.930, 0.153), (1.10, 0.270). The K/(L + M) ratio for the line at 0.153 MeV is 7.85 and for the line at 0.270 MeV is 5.77. The 16 hr isomer exhibits positrons of end-point energy 0.627 MeV; and two gamma rays of energy 1.76 and 0.645 MeV. A disintegration scheme is given.

539.16

20390 DECAY SCHEME OF Dy^{159}.

R.C.Greenwood and E.Brannen.

Phys. Rev., Vol. 120, No. 4, 1411-14 (Nov. 15, 1960).

The electron capture decay of Dy^{159} is shown to occur appreciably only to the 58 keV state and ground state of Tb^{159}, with branching ratios of 37% and 63% respectively. The K internal conversion coefficient of the 58 keV transition was measured to be $\alpha_K = 8.5_{-1.2}^{+0.7}$, which is consistent with a predominantly M1 transition, with the possibility of some E2 mixing. The orbital electron capture ratio to the 58 keV state of Tb^{159} was obtained as $P_{LM}.../P_K = 0.17 \pm 0.15$. From this value, a minimum decay energy to the ground state of Tb^{159} was assigned as 230 keV. The upper limit on transitions to the 138 and 364 keV states of Tb^{159} was placed at 0.1%. A spin and parity of $\frac{3}{2}-$ was assigned to the ground state of Dy^{159} from a consideration of log ft values. An upper limit of 450 keV was placed on the decay energy to the ground state of Tb^{159}.

539.16

20391 RADIOACTIVE DECAY OF Lu^{170}.

R.G.Wilson and M.L.Pool.

Phys. Rev., Vol. 120, No. 3, 980-2 (Nov. 1, 1960).

Ytterbium oxide enriched to 81.4% in the 170 mass number w irradiated with 6 MeV protons. An activity decaying by electron capture with a half-life of (2.05 ± 0.05) days was produced and assigned to Lu^{170} by the identification of the ytterbium K X-ray a by comparison with the activities produced by similar proton irra ations of each of the other enriched isotopes of ytterbium. The o served activity consists of the ytterbium K X-ray, gamma rays w energies of 84, 193, 245, 1010, 1030, 1165, 1275, 1415, 2035, 2365 2665, 2890, and 3085 keV, and a small amount of annihilation radi ation. Because no particle radiation exists, the mode of decay of Lu^{170} is solely by electron capture to Yb^{170}. Gamma—gamma coin dence measurements have led to the postulation of levels in Yb^{170} 2120 (0), 2365 (1 or 2), 3170 (3), and 3395 (1 or 2) keV in addition to the previously assigned 84 (2+), and 278 (4+) levels. A partial energy level scheme with approximate electron capture branching ratios is proposed.

539.

20392 K-ELECTRON CAPTURE BRANCH OF Sr^{87m}.

A.W.Sunyar and M.Goldhaber.

Phys. Rev., Vol. 120, No. 3, 871-3 (Nov. 1, 1960).

The existence of a (0.65 ± 0.25)% K-electron capture branch i the decay of 2.8 hr Sr^{87m} was established by means of an "internal source" technique. The low log ft = 4.25 and small energy release of 115 keV make this K branch especially interesting because it establishes Rb^{87} as a possible low-threshold detector for the inver neutrino capture reaction, $Rb^{87} + \nu \rightarrow Sr^{87m} + e^-$, which could be identified by observing the characteristic decay of the Sr^{87m} isome

539.1

20393 RADIOACTIVE DECAY OF Yb^{167}.

R.G.Wilson and M.L.Pool.

Phys. Rev., Vol. 120, No. 4, 1296-7 (Nov. 15, 1960).

Erbium oxide enriched to 35.1% in the mass number 164 was irradiated with 17 and 24 MeV alpha particles. An activity decayin by electron capture with a half-life of 17.7 ± 0.2 min was produced and its assignment to Yb^{167} confirmed by the identification of the thulium K X-ray and the well-known daughter activity of Tm^{167}. Gamma rays with energies of 106, 113, and 176 keV were observed in the spectrum of Yb^{167}. Gamma—gamma coincidence measurements were performed on the observed radiations. Transition prob abilities, multipole order admixtures, and electron capture branching ratios were calculated. Approximately 89% of the electron capture transitions occur to the 292.7 keV $(\frac{7}{2}-)$ level of Tm^{167}.

539.1

20394 A NEW ISOTOPE: CADMIUM 103.

I.L.Preiss, P.J.Estrup and R.Wolfgang.

Nuclear Phys., Vol. 18, No. 4, 624-7 (Sept. (2), 1960).

A new activity, produced by 160 MeV O^{16} bombardments of thick molybdenum oxide targets, was assigned to Cd^{103} on the basis of chemistry and its decay to Ag^{103}. The isotope Cd^{103} had a half-life of 10 ± 1.5 min and decayed by positron emission accompanied by 0.22, 0.62 and 0.85 MeV gamma-rays.

539.1

20395 NEW NUCLIDE, KRYPTON-74.

J.H.Gray, III, H.L.Hamester and A.A.Caretto, Jr.

Phys. Rev., Vol. 120, No. 3, 977-9 (Nov. 1, 1960).

A new nuclide of krypton, Kr^{74}, has been produced by high-ener proton interaction with strontium. It was found to have a half-life o 20 ± 1 min and to decay by 3.1 ± 0.14 MeV positrons. No gamma r in the energy range 0.04 to 4.0 MeV were observed. Evidence for t production of Kr^{75} was also observed. Calculations indicate an uppe limit for the half-life of 0.8 ± 0.4 min.

539.1

20396 DECAY OF Y^{88}.

M.K.Ramaswamy and P.S.Jastram.

Nuclear Phys., Vol. 19, No. 3, 243-7 (Oct. (3), 1960).

The weak positron spectrum in the decay of 105 day Y^{88} was measured in coincidence with the 1.86 MeV gamma-ray and annihilation radiation. The spectrum had an end-point energy of 560 ± 30 keV. The spectral shape was found to be characteristic of a unique first-forbidden transition (ΔJ = 2, yes), thus confirming a pin assignment for the ground state of Y^{88}. A search was made possible 0^+ excited level below the 1.86 MeV (2^+) level in Sr^{88}, negative results. An upper limit of 100 keV could be set on possible E2 transition to such a state.

539.16

20397 LIFETIMES OF ROTATIONAL LEVELS IN SOME ODD-A NUCLEI MEASURED BY A MICROWAVE THOD.

A.E.Blaugrund, Y.Dar and G.Goldring.
s. Rev., Vol. 120, No. 4, 1328-40 (Nov. 15, 1960).

Measurements of mean lives of the first excited states of a ber of odd-A nuclei were made with the intention of obtaining e accurate information on magnetic transition probabilities than present available. Most of these mean lives are in the range – 20 × 10^{-11} sec, and for this measurement a special timing aratus was devised which consists of a microwave beam pulsing em and a beta-ray spectrometer and cavity combination which as a microwave shutter. In four cases the exponential decay d be determined directly; these were the first excited states of ^{75}, Hf^{179}, and Ta^{181}, and the 118 keV level of Tm^{169}. The results these levels are: $\tau(Tm^{169}) = (9.0 \pm 0.4) \times 10^{-11}$ sec, $\tau(Lu^{175})$ $4.6 \pm 1) \times 10^{-11}$ sec, $\tau(Hf^{179}) = (5.4 \pm 0.4) \times 10^{-11}$ sec, and $a^{181}) = (6.0 \pm 0.5) \times 10^{-11}$ sec. Lifetime measurements were carried out for the first excited states of Hf^{177}, Re^{185}, and Re^{187}. limitations and scope of this method of measuring lifetimes discussed.

539.16

20398 ELECTRIC-MONOPOLE-ENHANCED $2^{+'}-2^+$ TRANSITIONS IN Th^{232} AND U^{238}.

.Durham, D.H.Rester and C.M.Class.
s. Rev. Letters, Vol. 5, No. 5, 202-5 (Sept. 1, 1960).

Internal conversion electrons from the isotopes $Th^{230,232}$ and ^{4,236,238} Coulomb-excited by 5 MeV protons have been observed. veral of these electron groups have been interpreted as resulting m electric monopole enhanced transitions between $2^{+'}$ beta-vibranal states and 2^+ first rotational states. Gamma-ray data is also ailable for U^{238} and Th^{232} and these cases are discussed in detail. r U^{238}, a 991 keV transition is interpreted as the E0 enhanced $'-2^+$ cascade from the 1036 keV beta-vibrational state. Combined h γ-ray measurements a total reduced transition probability 2.6 nes the single particle value is obtained. In Th^{232} a strong monopole hanced 725 keV transition and a weak 738 keV E2 transition are served. These are part of cascades originating in a beta-vibranal state at 775 keV and a γ-vibrational state at 788 keV. The ak yield of conversion electrons from the 788 keV transition was so measured. For this transition the ratio of the reduced transin probability to the single particle value was 3.8 or 2.1 times the ngle particle value, depending on the method of analysis, and for e 775 keV transition the factor was 1.4 or 3.1. The results have en used to calculate the value of $\mu(2^{+'};2^{+'}-2^+)$, the ratio of E0 E2 transition probabilities and the nuclear monopole strength rameter ρ. These have been compared with the theoretical predtions of Reiner; agreement for μ is good in the case of Th^{232}, but e experimental results are a factor of 10 less than the predictions r U^{238}.

R.E.Meads

539.16

20399 INVESTIGATION OF POLARIZATION OF THE INTERNAL-CONVERSION ELECTRONS IN TRANSITIONS OLLOWING β^--DECAY OF HEAVY ELEMENTS.

.E.Vishnevsky, V.A.Lyubimov, E.F.Tret'yakov and G.I.Grishuk.
n. eksper. teor. Fiz., Vol. 38, No. 5, 1424-9 (1960). In Russian.

Polarization of the conversion electrons was measured for ansitions following β-decay in Tm^{170}, Re^{186}, Hg^{203} and Pa^{233}. or Tm^{170} and Re^{186}, the conversion electrons were found to be larized in the direction of emission of the β-particles and for Hg[illegible] nd Pa^{233} in the opposite direction. The most probable values of the round state spins of β-decaying nuclei were determined for Hg^{203} nd Pa^{233}. The experimental data for Tm^{170} and Re^{186}, for which all ansition constants are known, were compared with the theoretical olarization values.

539.16

20400 THE INFLUENCE OF PAIR CORRELATION OF NUCLEONS ON THE PROBABILITIES OF ELECTROMAGNETIC TRANSITIONS IN [DEFORMED] NUCLEI.

Yu.T.Grin'.
Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 138-40 (July, 1960).

It is shown that the quasi-one-particle electric multipole transitions in the neighbourhood of the Fermi surface are forbidden by a actor ~ $A^{-2/3}$ compared with the one-particle transitions.

539.16 : 539.14

20401 PROBABILITIES FOR ROTATIONAL γ-TRANSITIONS OF THE E2 TYPE AND THE QUADRUPOLE MOMENTS OF DEFORMED NUCLEI WITH K = 1 AND K = $\frac{1}{2}$.

D.A.Varshalovich
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 461-2 (Aug., 1960). In Russian.

Expressions for B(E2) and Q are given for those cases in which these quantities not only depend on the direct matrix element but on the diagonal element as well.

539.16

20402 DETERMINATION OF ABSOLUTE Bρ-VALUES OF CONVERSION LINES.

C.de Vries.
Nuclear Phys., Vol. 18, No. 3, 428-45 (Sept. (1), 1960).

A recently constructed Siegbahn—Edvarson type iron-free double-focusing spectrometer was used to determine absolute Bρ-values of electron lines. The instrument was found to have high resolution (a few parts in 10^4) and high accuracy in the line positions (about 1 : 10^5). The effects of natural line width and source thickness on the adopted line position definition were investigated. The absolute Bρ-values of some conversion lines occurring in the spectrum of the ThB-active deposit (covering the energy range from 150 keV to 2.6 MeV) were determined with an accuracy of about one part in 10^4. Comparison with published values for these Bρ-values showed the linearity of the instrument to be better than 1 : 10^4 for the energy region considered. See also two following abstracts.

539.16

20403 PRECISION MEASUREMENTS OF ENERGIES OF GAMMA-RAYS FOLLOWING THE DECAY OF SOME GOLD ISOTOPES.

C.de Vries and J.H.Dijkstra.
Nuclear Phys., Vol. 18, No. 3, 446-53 (Sept. (1), 1960).

The energies of eight gamma-rays occurring in the decay of some gold isotopes were determined from their conversion-line momenta as measured with an iron-free double-focusing spectrometer. The Bρ-assignments to the lines following the decay of Au^{194}, Au^{196}, Au^{196} (10 hr) isomer and Au^{198} were obtained by using the conversion lines of the 158 keV transition in Hg^{199} as calibration line. Absolute Bρ-values of the latter lines could be determined applying the self-consistent method of Siegbahn. Disregarding the calibration uncertainty (about one part in 10^4) the accuracy reached in the energies of the gamma-rays is about 7 parts in 10^5. The value 411.766±0.028 keV for the energy of the well known E2 transition in Hg^{198} is in good agreement with other values, some of which were determined directly with a curved crystal. See also preceding and following abstract.

539.16 : 539.14

GAMMA-TRANSITION PROBABILITIES IN F^{19}.

See Abstr. 20354

539.16

20404 ABSOLUTE AND RELATIVE CONVERSION DETERMINATIONS OF PURE E2 TRANSITIONS OCCURRING IN Hg^{198}, Hg^{199}, Pt^{194} AND Pt^{196}.

C.de Vries, E.J.Bleeker and N.Salomons-Grobben.
Nuclear Phys., Vol. 18, No. 3, 454-72 (Sept. (1), 1960).

Conversion coefficients of some pure E2 transitions following the decay of some gold isotopes were determined using an iron-free double focusing spectrometer of the Siegbahn—Edvarson type. The α_K of the 412 keV transition in Hg^{198}, the 328 keV transition in Pt^{194} and the 354 keV transition in Pt^{196} were determined using the external—internal method as recently improved by Hultberg and Stockendal. The results indicate that the theoretical values for these conversion coefficients are 10 to 20% too high. Some additional measurements make the explanation of these deviations by systematical errors improbable. Experimental relative conversion coefficients (K/L, $L_I/L_{II}/L_{III}$) of the 412 keV transition in Hg^{198} indicate the deviations found for the absolute K-conversion coefficients to be present also for the L-shells. The results for the ratios L/M of the 412 keV transition in Hg^{198} and $M_I/M_{II}/M_{III}$ of the 158 keV transition in Hg^{199} suggest a correction factor of 0.6 to be applied to the theoretical values of the conversion coefficients for the M-subshells, not corrected for screening. See also two preceding abstracts.

539.1

20405 THEORY OF E0 TRANSITIONS OF SPHEROIDAL NUCLEI.

J.O.Rasmussen.
Nuclear Phys., Vol. 19, No. 1, 85-93 (Sept. (3), 1960).

The nuclear matrix elements for E0 transition probabilities associated with beta-vibrational transitions of spheroidal nuclei are derived by two different models. The first model, previously studied by Peaslee (1957) and by Reiner (1958), involves the volume-conserving quadrupole surface oscillations of a uniformly-charged spheroid about an equilirbium deformation of β. The second model sums over the coherent contributions of all the proton orbitals involved in an individual particle representation of the collective motion. The second model when corrected for volume-conservation gives about twice the ratio of E0 to E2 for Sm^{152} and Pu^{238} given by the first model. A brief comparison with experiment is made, showing satisfactory agreement for Pu^{238} and serious disagreement for Sm^{152}.

539.16

20406 RARE E2 TRANSITION IN C^{13}.
R.E.Pixley, J.V.Kane and D.H.Wilkinson.
Phys. Rev., Vol. 120, No. 3, 943-5 (Nov. 1, 1960).

By means of a coincidence method it is shown that the $\frac{5}{2}+$ state of C^{13} at 3.86 MeV has an E2 branch of relative strength $(9.3 \pm 2.0) \times 10^{-3}$ to the $\frac{1}{2}+$ state at 3.09 MeV. From consideration of the likely strengths of the competing E1 transition to the $\frac{3}{2}-$ state at 3.68 MeV and the M2 transition to the ground state it is deduced that this branching ratio implies an E2 transition speed of the order of a single-particle (proton) unit. This in turn demands the substantial participation of at least one excited state of C^{12} in the parentage of at least one of the C^{13} states with respect to the 1d or 2s neutron. This eliminates in particular a jj-coupling description of C^{13} in which the two states in question are $1d_{5/2}$ and $2s_{1/2}$ neutron states and more generally a weak-coupling model in which the ground state of C^{12} is the unique parent for the C^{13} states (with respect to 1d and 2s neutrons).

539.16 : 539.17

ANOMALOUSLY WEAK GROUND-STATE TRANSITION FROM 13.51 MeV STATE OF Ne^{20}. See Abstr. 20442

539.16

20407 L AND M CONVERSION RATIOS IN Os^{192} AND Pt^{192}.
L.Marinkov, M.Mladjenović, R.Stepić and M.Župančić.
Nuovo Cimento, Vol. 15, No. 3, 496-7 (Feb. 1, 1960).

Internal conversion spectra of various γ-rays from excited states of Pt^{192} and Os^{192} resulting from β and electron-capture decay of Ir^{192} were measured using an iron-free double-focusing electron spectrometer. For one transition expected to be pure E2, the 205.9 keV transition in Os^{192}, the ratio L_1:L_2:L_3 of the conversion lines was measured and was in good agreement with theory [Rose, Internal conversion coefficients, Amsterdam: North-Holland Publishing Co. (1958)]. In other E2 cases where the L_1 and L_3 lines could not be resolved, the ratio $(L_1 + L_2)$:L_3 was also in agreement with the theoretical values. In the case of two transitions of 136 keV and 201 keV with M1/E2 mixing, identical values of the mixing ratio were obtained from measurements of the conversion ratios L_2:L_1 and L_3:L_1. M lines were measured for the 205, 295, and 316 keV transitions but complete resolution of M_1, M_2 and M_3 was not possible. Estimated ratios agreed with theoretical values to better than 10%.
R.E.Meads

539.16

20408 MEASUREMENTS OF DELAYED COINCIDENCES IN Sn^{116}.
A.Meessen and L.Grenacs.
J. Phys. Radium, Vol. 20, No. 8-9, 764 (Aug.-Sept., 1959).
In French.

Angular correlation measurements, with a coincidence circuit resolving time 2.5×10^{-8} sec, on the 0.410 MeV—2.150 MeV γ-cascade of Sn^{116} arising from In^{116} have revealed a difference between the results for a solid source and those for a liquid one. The latter approach well the results of Scharenberg for a solid Sn^{116} source (Abstr. 2367 of 1956), obtained with a resolving time 1×10^{-8} sec. The γ-cascade studied corresponds to a half-life $(1.0 \pm 0.1) \times 10^{-8}$ sec and consists of a prompt and a delayed cascade, the ratio γ delayed/γ prompt being 1.7. Two alternative decay schemes are suggested but it was not possible to conclude that the second level was that of 2.21 MeV Sn^{116} arising from Sb^{116}.
I.C.Demetsopoullos

539.16

20409 GAMMA—GAMMA ANGULAR CORRELATIONS IN Tm^{169}.
S.D.Koički, J.M.Simić and A.H.Kukoč.
Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 9, 29-37 (March, 1959).

It was found that both K-forbiden transitions of 177 and 198 keV are mixtures of M1 and E2 multipoles. The magnitudes and the interference signs of these mixtures have been determined. The probabilities of partial M1 and E2 components, de-exciting the 7/2(K = 7/2) particle state to the members of the K = $\frac{1}{2}$ rotational family, are given.

53

20410 THE 85 MINUTE ACTIVITY OF Ba^{139}.
W.H.Kelly, G.B.Beard, W.B.Chaffee and J.M.Gonser.
Nuclear Phys., Vol. 19, No. 1, 79-84 (Sept. (3), 1960).

The decay scheme of Ba^{139} was studied using scintillation detectors. The half-life was found to be 85 ± 3 min. Beta—gam
and gamma—gamma coincidence measurements showed this deca
to consist of three beta-groups of 2.38, 2.23 and 0.95 MeV, leadi
to the ground state and two excited states of La^{139}, the energies o
the excited states being 0.167 ± 0.003 and 1.43 ± 0.05 MeV. Transitions from these two states were to the ground state. Branching ratios of 0.72, 0.26 and 0.02 were found for the 2.38, 2.23 and 0.95 MeV beta-groups, respectively. Beta--gamma delayed coincidence measurements made on the 0.167 MeV state showed the half-life of this state to be 1.7 ± 0.2 nsec.

539

20411 $\beta-\gamma$ CORRELATION OF THE $3^{-}-2^{+}-0^{+}$ CASCADE I THE DECAY OF Eu^{152}.
J.W.Sunier, P.Debrunner and P.Scherrer.
Nuclear Phys., Vol. 19, No. 1, 62-7 (Sept. (3), 1960).

The $\beta-\gamma$ directional correlation of the $3^{-}-2^{+}-0^{+}$ cascade in
decay of Eu^{152} was measured as a function of beta-particle energy
The anisotropy factor $\epsilon(W)$ in the $\beta-\gamma$ directional correlation $N(W,\theta) = 1 + \epsilon(W)\ P_2(\cos\theta)$ was found to be $\epsilon(3.5\ m_0c^2) = -0.46 \pm 0.02$ near maximum beta-energy. The nuclear matrix elements involved in the observed beta-transition were computed from the measured values of $\epsilon(W)$ and from the shape correlation factor. The data imply that the relative contribution of the $\int B_{ij}$ matrix element is unusually large, as was expected on the basis o
the large deviation from the allowed shape of the beta-spectrum. The reduction of the matrix elements other than $\int B_{ij}$ can be cause
by a selection rule effect.

539.

20412 THE LEVEL SCHEME OF Ta^{181}.
H.A.Vartapetyan and A.G.Khudaverdyan.
Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 25-6 (July, 1960).
In Russian.

By means of the $\beta-\gamma$ coincidence, it was shown that a 137 keV transition between 619 and 482 keV levels ($T_{1/2} = 10^{-8}$ sec) does no
exist, but some new γ-transitions were detected at 619, 480 and 345 keV. The lifetime of the 619 keV level is less than 10^{-9} sec.

539

20413 DECAY OF Au^{196m}.
T.M.Kavanagh.
Canad. J. Phys., Vol. 38, No. 11, 1436-40 (Nov., 1960).

The isomeric state in Au^{196} decays to the ground state with an initial M4 transition of energy 175.5 ± 0.5 keV, followed by 148.2 ± 0.5 keV and 188.8 ± 0.5 keV transitions in cascade; a transition of 85.0 ± 0.5 keV is probably also in cascade with these transitions. There is evidence of a weak 135.9 ± 0.5 keV transitio
converted in Pt, indicating a small electron capture branch in the decay. The half-life of the isomeric state is 9.5 ± 0.3 hr.

539.16 : 539.

20414 GAMMA-RADIATION FROM EXCITED STATES OF F^{16} Na^{22}, AND Ne^{22}.
T.A.Rabson, T.W.Bonner, R.Castillo-Bahena, M.V.Harlow, Jr, H.P.Haenni and W.A.Ranken.
Nuclear Phys., Vol. 19, No. 3, 314-26 (Oct. (3), 1960).

A study of the γ radiation from $O^{18} + p$, $O^{16} + He^{3}$ and $F^{19} + \alpha$ has been made in an effort to learn more about the energy level structure of F^{18}, Na^{22} and Ne^{22}. Gamma-radiation was studied by means of a magnetic lens photo-conversion spectrometer and a NaI
spectrometer. Gamma-rays from the bombardment of an O^{18} targe
with protons were observed with energies 0.511 ± 0.004, 0.666 ± 0.005, 0.938 ± 0.006, 1.043 ± 0.008, 1.082 ± 0.010 and 1.990 ± 0.010 MeV. Gamma-rays from the bombardment of an O^{16} target with 2.83 MeV He^{3} particles were observed with energies of 0.189 ± 0.005, 0.66 ± 0.02, 0.95 ± 0.02, 1.07 ± 0.02, 1.71 ± 0.03, 2.14 ± 0.03, 2.54 ± 0.03, and 3.11 ± 0.05 MeV. The internal-conversion coefficient of the 0.189 MeV radiation was measured to be $(2.86 \pm 0.4) \times 10^{-3}$. The energies of the gamma-radiation from the

-particle bombardment of a F^{19} target were observed to be + 0.002, 0.109 ± 0.002, 0.586 ± 0.004, 0.892 ± 0.005, ± 0.008, 1.530 ± 0.010 and 2.090 ± 0.016 MeV. The internal-rsion coefficients of the 0.073, 0.109 and 0.586 MeV gammas observed to be $(4.5 \pm 0.4) \times 10^{-3}$, $(2.8 \pm 0.5) \times 10^{-3}$ and $\pm 0.3) \times 10^{-4}$, respectively.

539.16

DECAY OF I^{124}.

415 K.Sugiyama, H.Ikegami, Y.Yamazaki and M.Sakai.
ys. Soc. Japan, Vol. 14, No. 8, 986-91 (Aug., 1959).

The gamma and beta rays following the decay of I^{124} (produced e Sb(α,n) reactions) were studied with scintillation spectro-rs, both single and in coincidence, and with a beta-ray spectro-r. Three gamma rays at 2.74, 2.29 and 1.50 MeV and one pro- at 0.9 MeV, which were not found in the decay of Sb^{124}, were rved. The beta—gamma coincidence experiments revealed that irst positron group decays to the ground level of Te^{124}, so that energy difference between I^{124} and Te^{124} becomes 3.22 MeV, being istent with beta decay energy systematics. In addition, this beta ponent was found to have a unique first forbidden type spectrum, ving that the spin and parity of the ground state of I^{124} is 2−. m these results, it is concluded that two levels at 2.88 and 2.74 exist, of which the spin value is probably 1 and the parity is tive. A doublet level at the second excited level previously orted was not confirmed in the present experiment. However, nite evidence of a cross-over transition from the second level he ground level was obtained which may indicate the presence of level at the second excited level. A tentative decay scheme is posed.

539.16

THE LEVELS IN ^{121}Sb STUDIED FROM THE DECAY OF $^{121}Te^m$ AND ^{121}Te. R.K.Gupta.

0416
vo Cimento, Vol. 17, No. 5, 665-70 (Sept. 1, 1960).

The levels were investigated by a single crystal NaI(Tl) spectro-ter and coincidence scintillation spectrometer studies. From the ncidences between low intensity 1130 and 70 keV γ-rays and be-en 506 and 70 keV γ-rays, excited levels at 70, 575, and 1100 keV b^{121} are inferred. The new level at 70 keV agrees with the tematics of $\frac{7}{2}^{+}$ levels in this region.

539.16

DECAY OF Si^{26}.

20417 E.L.Robinson and O.E.Johnson.
ys. Rev., Vol. 120, No. 4, 1321-7 (Nov. 15, 1960).

A (2.1 ± 0.3) sec activity was observed when vacuum distilled agnesium was bombarded with 8 MeV He^3 ions. Half-life studies ing NaI(Tl) scintillation counters yielded evidence that this activity s due to the decay of a positron-emitting isotope with a maximum netic energy greater than 3.5 MeV. The features of the gamma-y spectrum with the exception of a weak line at 824 ± 15 keV could understood in terms of the decay characteristics of known radio-otopes. An internally consistent argument based on the known de-y characteristics of reaction products that may be expected from ergy considerations, the results of half-life studies, experimental mma spectra, and nuclear systematics can be made to support the nclusion that the (2.1 ± 0.3) sec half-life is that of Si^{26} produced in e reaction $Mg^{24}(He^3,n)Si^{26}$, and a consistent decay scheme can be roposed. The ground state of $Si^{26}(0+)$ decays by the emission of two ositron groups to excited states of Al^{26}. The most intense tran-ition, $E_0 = 3.76$ MeV, is to the 0.228 MeV state (0+) of Al^{26}. The econd transition, $E_0 = 2.94$ MeV, is to the 1.05 MeV state (1+) of l^{26}. The 1.05 and 0.228 MeV states are then connected by a 324 ± 15) keV gamma transition. The energies of the positron tran-ition are derived from the known levels of Al^{26} and the Si^{26}—Al^{26} ass difference

539.16 : 539.14

LOWER EXCITED STATES OF W^{185}.

20418 H.Morinaga and K.Nagatani.
uclear Phys., Vol. 19, No. 3, 327-36 (Oct. (3), 1960).

The decays of Ta^{185} and W^{185m} were investigated using a scintilla-on spectrometer with a coincidence circuit. The sources were repared from photodisintegration of metallic tungsten. Gamma-rays bserved were essentially the same as previous results by Pöe (1955) xcept for a few new lines. A decay scheme is proposed for both ecays. The decay of Ta^{185} is consistently explained by the unified nodel for strongly deformed nuclei. The isomer, however, is diffi-ult to explain with the unified model. It is suggested that the iso-neric state may represent a spherical state.

539.16

ANGULAR CORRELATION OF GAMMA RAYS FROM Xe^{126} AND Te^{126}.

20419
M.Sakai, H.Ikegami, T.Yamazaki and K.Sugiyama.
J. Phys. Soc. Japan, Vol. 14, No. 8, 983-6 (Aug., 1959).

The correlation of gamma rays in 2—2—0 cascade transitions was measured from the decay of I^{126} in order to obtain the mixing ratio of competing E2 and M1 transitions in the 2—2 transition. The mixing ratio is found to have a positive sign for both nuclei, as expected from the systematics of excited levels in even—even nuclei.

NUCLEAR REACTIONS

539.17 : 537.54

THE CERN SYMPOSIUM. See Abstr. 19813-14

539.17

ANGULAR DISTRIBUTIONS AND POLARIZATION IN STRIPPING PROCESSES AND IN DIRECT REACTIONS.

20420
L.J.B.Goldfarb and R.C.Johnson.
Nuclear Phys., Vol. 18, No. 3, 353-94 (Sept. (1), 1960).

General expressions are found for angular distributions and polarization effects in a variety of direct reactions. These reactions include processes involving the stripping of deuterons and of heavier nuclei, in addition to inelastic-scattering phenomena which arise either from individual nucleon—nucleon encounters or from collective effects at the nuclear surface. Various selection rules are found for the existence of polarization, using the distorted-wave Born approximation and allowing for spin-dependent distortions. The influence of a neighbouring isolated resonance state of the compound nucleus is examined, and modifications are found of the general results. Expressions are given for the angular correlation of the γ-rays following de-excitation of the residual nucleus.

539.17

A REMARK ON THE COULOMB DISINTEGRATION OF ACCELERATED HEAVY IONS. J.M.Hansteen.

20421
Nuclear Phys., Vol. 19, No. 3, 309-13 (Oct. (3), 1960).

The Coulomb disintegration of heavy ions was treated by a semi-classical perturbation method, taking the repulsion of the bombarding particle in the Coulomb field of the target nucleus into account. The cross-section for the electric break-up of C^{12} nuclei into three α-particles in nuclear emulsions was found to be of the order of 10^{-27} cm^2 for projectile energies of approximately 100 MeV. This seems to be in conformity with the very scanty experimental data.

539.17

PREFORMATION FACTOR IN EMISSION OF COMPLEX PARTICLES FROM NUCLEAR REACTIONS.

20422
B.L.Cohen.
Phys. Rev., Vol. 120, No. 3, 925-7 (Nov. 1, 1960).

The reason why complex particles (alphas, tritons, Li^6 nuclei, etc.) are emitted in nuclear reactions as frequently as nucleons (after corrections for Coulomb barrier penetration and energetics), whereas ice crystals are never emitted from evaporating water droplets, is investigated. It is shown that the difference is entirely explained by the fact that a nucleus is a highly degenerate system subject to Fermi—Dirac statistics, whereas an evaporating water droplet is a nondegenerate statistical system.

539.17

INTERPRETATION OF ISOMERIC CROSS-SECTION RATIOS FOR (n,γ) AND (γ,n) REACTIONS.

20423
J.R.Huizenga and R.Vandenbosch.
Phys. Rev., Vol. 120, No. 4, 1305-12 (Nov. 15, 1960).

The relative probability of forming each member of a pair of nuclear isomeric states has been compared with theoretical predictions in order to learn which nuclear parameters can be determined from these data. For thermal-neutron capture reactions, the observed ratios do not give much information about the dependence of the nuclear level density on spin, but they are consistent with a spin cutoff factor, $\exp[-(J+\frac{1}{2})^2/2\sigma^2]$, where $\sigma \leq 5$. The calculations are sufficiently consistent with experiment to make their predictions usable as a guide for assigning spins to the compound states formed in thermal or resonant energy neutron capture. For (γ,n) reactions, the calculations reproduce the energy dependence of the experimentally observed isomeric cross-section ratios. In order to obtain quantitative information about the spin dependence of the nuclear level density, it is necessary to consider reactions where particles are emitted which can carry off enough angular momentum to reach many spin states of the residual nucleus. See also following abstract.

539.17

20424 ISOMERIC CROSS-SECTION RATIOS FOR REACTIONS PRODUCING THE ISOMERIC PAIR $Hg^{197,197m}$.

R.Vandenbosch and J.R.Huizenga.
Phys. Rev., Vol. 120, No. 4, 1313-18 (Nov. 15, 1960).

Excitation functions and isomeric cross-section ratios were determined for the $Au^{197}(p,n)$ and $Au^{197}(d,2n)$ reactions. Isomeric cross-section ratios were also determined for the $Hg^{196}(n,\gamma)$, $Hg^{196}(d,p)$, $Hg^{198}(n,2n)$, $Hg^{198}(\alpha,\alpha n)$, and $Pt(\alpha,xn)$ reactions. Those reactions for which compound nucleus formation predominates are treated by a statistical model. In this treatment the compound state is characterized by angular momentum and excitation energy. The analysis yields a value of 4 ± 1 for the parameter σ which characterizes the dependence of the nuclear level density on angular momentum. Relatively small amounts of angular momentum are transferred in reactions which proceed predominantly by a direct interaction mechanism. Such reactions, therefore, give a larger yield of the isomer with spin closer to that of the target nucleus.

539.17

20425 SURVEY OF TRITIUM-PRODUCING NUCLEAR REACTIONS.

J.Gonzalez-Vidal and W.H.Wade.
Phys. Rev., Vol. 120, No. 4, 1354-9 (Nov. 15, 1960).

(p,t), (d,t) and (α,t) reactions were investigated throughout the periodic table by bombarding stacked metal foils and determining directly the tritium produced in the reaction. In the (α,t) reactions, there is conclusive evidence that most of the tritons are produced with high energies, thus indicating the presence of direct interaction processes. The curve representing the integrated cross section versus Z of the target rises with decreasing Z. This, and the appearance of low-energy peaks in the individual excitation functions of low-Z targets indicate that at low and intermediate values of Z the relative number of low-energy tritons increases. These tritons are probably the product of a compound-nucleus mechanism. For the (p,t) and (d,t) reactions the same compound-nucleus and direct-interaction effects are noticed.

539.17

20426 INELASTIC DIFFRACTION SCATTERING.

E.Rost and N.Austern.
Phys. Rev., Vol. 120, No. 4, 1375-87 (Nov. 15, 1960).

The method of distorted waves Born approximation is shown to be equivalent to the first-order adiabatic method for the calculation of inelastic scattering. The flexibility of the distorted waves method is indicated and tested by numerical calculation for a simplified model. The calculations treat the inelastic scattering of alpha particles from strongly absorbing nuclei, and are directly comparable to the adiabatic calculations considered by Blair (Abstr. 432 of 1960) in Fraunhofer approximation. Good agreement is found at forward angles. Coulomb wave-functions are used, and the energy difference between initial and final states is taken into account. Comparison is made to a few representative experiments and good agreement is found.

539.17

20427 OPTICAL MODEL ANALYSIS OF NUCLEAR SCATTERING.

B.Buck, R.N.Maddison and P.E.Hodgson.
Phil. Mag. (Eighth Ser.), Vol. 5, 1181-91 (Nov., 1960).

The mathematical methods used in a calculation of nuclear interactions by the optical model are described, and the most efficient way of programming the calculation for an electronic computer investigated.

539.17

20428 DETERMINATION OF THE FORWARD SCATTERING AMPLITUDE FROM THE OPTICAL-MODEL POTENTIAL IN THE HIGH-ENERGY LIMIT.

R.Lipperheide and D.S.Saxon.
Phys. Rev., Vol. 120, No. 4, 1458-9 (Nov. 15, 1960).

A relation between the two-particle forward scattering amplitude, $f_k(0)$, and the volume integral over the optical potential, $V_k(x)$, is given in the high-energy limit, which is valid at least to second order in the two-body interactions, neglecting correlation and exchange terms. The relation is:

$$\int V_k(x)dx = -(2\pi\hbar^2/m)Af_k(0),$$

where A is the number of nucleons in the target, and m is the reduc mass of the two-particle system. The connection between the shape of the optical-model potential and the density distribution of the target nucleus is discussed.

539.17 : 539.1

20429 INTERFERENCE BETWEEN COULOMB AND NUCLEAR SCATTERING AT HIGH ENERGIES.

B.P.Bannik and V.G.Grishin.
Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 94-6 (July, 1960).
In Russian.

Considered in the quasi-classical approximation. Results of calculations are presented for the scattering of 8.7 BeV protons on light and heavy photographic emulsion nuclei. The magnitude and sign of the real part of the amplitude for the scattering of protons on protons are discussed.

539.17

20430 INFLUENCE OF COULOMB ATTRACTION ON THE CROSS-SECTION FOR ABSORPTION OF ANTIPROTONS BY NUCLEI.

P.E.Nemirovskii and Yu.D.Fiveiskii.
Zh. eksper.teor. Fiz., Vol. 38, No. 5, 1486-8(1960). In Russian.

Reports an investigation on the influence of Coulomb attraction of the nucleus on the cross-section for absorption of antiprotons whose energy is small compared with the Coulomb energy at the nuclear boundary. Interaction between antiprotons and nuclei is treated on the basis of the optical model. Calculations are presented for C, Cu and Pb nuclei for nuclear attraction and repulsion potentials. It is shown that due to Coulomb attraction the cross-section for antiproton absorption at energies below the Coulomb energy is 4 to 10 times greater than the cross-section for antineutrons of the Coulomb energy.

539.17

20431 CONCERNING A NEW METHOD OF IDENTIFICATION OF γ-EMISSION IN THE REACTIONS $(p,p'\gamma)$, (p,γ) AND $(p,n\gamma)$.

A.K.Val'ter, I.I.Zalyubovskii, A.P.Klyucharev and V.A.Lutsik.
Zh. eksper. teor. Fiz., Vol. 39, No. 4(10), 1159-61 (Oct., 1960).
In Russian.

The decrease in emission of γ-quanta, in $(p,p'\gamma)$ and (p,γ) reactions, for bombarding proton energies just above a (p,n) threshold, is described as a test for identifying γ-rays which arise in such reactions. The method is applied to the 770 keV and 1015 keV γ-emissions from a Cu^{65} target and the 465 keV and 1330 keV γ-emissions from a Co^{59} target. E.A.Sanderson

539.17

20432 CHARGED PARTICLE AND TOTAL REACTION CROSS SECTIONS FOR PROTONS AT 9.85 MeV.

V.Meyer and N.M.Hintz.
Phys. Rev. Letters, Vol. 5, No. 5, 207-9 (Sept. 1, 1960).

Using 9.89 MeV protons from the Minnesota linear accelerator, cross-sections $\sigma(p,q)$ for all reactions in which charged particles were emitted were measured for 11 elements from C to Sn. A CsI crystal and pulse height analyser were used to obtain the energy spectrum at each angle in 10^0 intervals between 20^0 and 150^0. The spectra were then integrated over energy and angle to give $\sigma(p,q)$. Using the rather scanty available data for $\sigma(p,n)$, lower limit values of the total reaction cross-section are calculated. These are compared with the optical-model predictions of Glassgold et al. (Abstr. 7377 of 1957) and Nodvik and Saxon (Abstr. 7549 of 1960). The optical-model values are 100-200 mb lower than the experimental values. It is suggested that data form strong evidence for $W(r)$ having a greater spatial extent than $V(r)$. A.Ashmore

539.17

20433 ENERGY SPECTRUM OF CASCADE α-PARTICLES IN PHOTOGRAPHIC EMULSION STARS PRODUCED BY HIGH ENERGY PROTONS.

V.I.Ostroumov, N.A.Perfilov and R.A.Filov.
Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 105-7 (July, 1960).
In Russian.

The energy spectrum of α-particles with energies above 30 MeV emitted in the disintegration of heavy photographic emulsion nuclei induced by 140, 200, 360 and 660 MeV protons was computed.

he lculations are based on the assumption of single elastic oll ons between cascade nucleons and intranuclear α-particles. he lculated and experimental distributions are compared and oun o be in good agreement if the kinetic energy of the α-particle t nucleus is assumed to equal 5—10 MeV.

539.17

34

NUCLEAR DISINTEGRATIONS IN A PHOTOGRAPHIC EMULSION PRODUCED BY 930 MeV PROTONS.

.V. ozhkin, N.A.Perfilov, A.A.Rimskii-Korsakov and zh] Fremlin.

Zh. sper. teor. Fiz., Vol. 38, No. 5, 1388-98(1960). In Russian.

iteraction between 930 MeV protons and photographic emulsion uc was investigated, special attention being paid to interactions nv ing emission of multi-charged particles with Z ≥ 3 from uc. The relative yield of hydrogen, helium and lithium nuclei nd nuclei with Z ≥ 4 was determined for light and heavy nuclei ns egrations with ≥ 3 prongs. For disintegrations of Ag and Br ne oss-section for lithium isotope production was found to equal 13 31)mb and the cross-section for production of fragments with ≥ was found to equal (62 ± 11) mb. Angular and energy distribu- ior of the fragments, multiplicity of fragment production, depen- en of the probability of fragment production on the number of ticles and protons in the disintegration and other fragmen- ati characteristics were determined. The fragmentation ne anism is discussed.

539.17

435

EXCITATION FUNCTIONS AND ANGULAR DISTRIBUTIONS OF THE REACTIONS $Al^{27}(p,\alpha)Mg^{24}$ AT 12 ~ 14.1 MeV AND $Cr^{52}(p,\alpha)V^{49}$ AT 9.0 ~ 14.2 MeV.

I. nabe, Ching Ling Qang, M.Kawashima, M.Yada and H.Ogata.

J. ys. Soc. Japan, Vol. 14, No. 6, 713-21 (June, 1959).

Making use of a proportional counter, alpha-particles were ob rved from the reactions $Al^{27}(p,\alpha)Mg^{24}$ resulting in the ground an irst excited states of Mg^{24} and $Cr^{52}(p,\alpha)V^{49}$ resulting in the lo st three and a few higher states. Excitation curves were m sured at a laboratory angle of 50° with respect to the bombard- in eam, from 12.7 to 14.1 MeV for $Al^{27}(p,\alpha)Mg^{24}$ and from 9.0 to 14 MeV for $Cr^{52}(p,\alpha)V^{49}$. The former shows a sharp energy de ndence, while the latter shows a fairly smooth structure. An lar distributions were measured at 14.1, 13.0 and 12.8 MeV for Al $p,\alpha)Mg^{24}$ and at 14.2, 13.0, 12.0, 11.0, 10.0, 9.5 and 9.0 MeV for C $(p,\alpha)V^{49}$ Although the $Al^{27}(p,\alpha_0)Mg^{24}$ data can be partially fitted $_2(Qr_0)]^2$ of Butler's theory, some angular distributions show st ng backward peaking. Either interference between various di ct interaction processes or between direct interaction and co pound nuclear precesses, or both are responsible for this re- ac on. The approximate 90° symmetry or $Cr^{52}(p,\alpha)V^{49}$ angular di ribution does not appear to be inconsistent with the statistical th ry of nuclear reactions. However, the conspicuous forward pe at higher energies, especially at 14.2 MeV, is considered to in cate the increasing contribution of direct interaction processes.

539.17

0436

INVESTIGATION OF SECONDARY (α, xn) REACTIONS IN BISMUTH.

W Yun-yui [Wang Yung-yü], V.V.Kuznetsov, M.Ya. Kuznetsova a V.A.Khalkin.

Z eksper. teor. Fiz., Vol. 39, No. 2(8), 230-4 (Aug., 1960). In R sian.

The absolute production cross-sections and relative yields of A ^{0} and At^{211} from bismuth irradiated by 120 to 660 MeV protons we e determined by a radiochemical method. The astatine iso- t es were produced in the (α, xn) reaction during capture by the ta get nucleus of α-particles with energies $E_\alpha > 20$ MeV produced a result of profound disintegration. The cross-sections for p duction of α-particles with energies $E_\alpha > 20$ MeV were com- p ed on basis of the experimental data and the shape of the energy s ctrum has been estimated.

539.17

0437

SECONDARY REACTIONS OF SPALLATION.

M.Lefort, G.Simonoff and X.Tarrago.

lear Phys., Vol. 19, No. 2, 173-83 (Oct. (1), 1960). In French.

In the spallation nuclear reactions induced by 150 MeV protons o bismuth and thallium, light fragments are produced. Alpha p ticles induce secondary reactions. By the radio-chemical study o astatine isotopes, cross-sections for (α, 2n) to (α, 6n) reactions measured. A cross-section of 60 ± 10 mb is calculated for the production of helion fragments, and the energy distribution given. An upper limit is estimated for the production cross-sections of lithium and beryllium fragments.

539.17

20438

ON THE PRODUCTION OF Be^7 IN THE N.R.X. REACTOR BY THE $B^{10}(p,\alpha)Be^7$, $Li^7(p,n)Be^7$, AND $Li^6(d,n)Be^7$ REACTIONS.

J.C.Roy, M.Bresesti and J.J.Hawton.

Canad. J. Phys., Vol. 38, No. 11, 1428-35 (Nov., 1960).

The Be^7 was identified by its half-life and gamma-ray energy. The (p,α), (p,n), and (d,n) reactions were initiated by protons and deuterons produced by neutron—hydrogen atom collisions and by neutron—deuterium collisions from the irradiation of boric acid, lithium hydroxide, and lithium deuteroxide, respectively. The same three reactions were also initiated by protons and deuterons produced by (n,p) and (n,d) reactions on boron, lithium, and other target elements chemically combined with lithium.

539.17

20439

THE ACTIVITIES INDUCED IN BERYLLIUM, OXYGEN AND FLUORINE BY PROTONS OF 220 MeV TO 362 MeV.

V.Parikh.

Nuclear Phys., Vol. 18, No. 4, 646-53 (Sept. (2), 1960).

The beryllium, oxygen and fluorine targets were bombarded in the internal proton beam of a 396 cm synchrocyclotron. The reaction cross-sections for various spallation products were measured at different energies. The behaviour of reactions induced by high-energy protons in some light elements is discussed.

539.17 : 539.12

QUASI-ELASTIC PROTON—PROTON SCATTERING AT 158 MeV. EXPERIMENTS ON $C^{12}(p,2p)B^{11}$. See Abstr. 20135

539.17

20440

ABSOLUTE CROSS-SECTIONS OF $C^{12}(p,pn)C^{11}$ FROM 288 TO 383 MeV.

V.Parikh.

Nuclear Phys., Vol. 18, No. 4, 628-37 (Sept. (2), 1960).

The excitation function for the reaction $C^{12}(p,pn)C^{11}$ was measured in the external proton beam of a 396 cm synchrocyclotron. The C^{11} activity was measured by a calibrated γ-ray G.M. counter. The results were compared with those reported from other laboratories. See following abstract.

539.17

20441

CROSS-SECTIONS FOR $Al^{27}(p,3pn)Na^{24}$, $Al^{27}(p,5p5n)F^{18}$ AND $C^{12}(p,3p3n)Be^7$ RELATIVE TO $C^{12}(p,pn)C^{11}$.

V.Parikh.

Nuclear Phys., Vol. 18, No. 4, 638-45 (Sept. (2), 1960).

The excitation functions for the reactions $Al^{27}(p,3pn)Na^{24}$, $Al^{27}(p,5p5n)F^{18}$ and $C^{12}(p,3p3n)Be^7$, were measured relative to $C^{12}(p,pn)C^{11}$ employing internal proton beam of a 396 cm synchrocyclotron. The results were compared with those reported from other laboratories. See also preceding abstract.

539.17 : 539.16

20442

RADIATIVE CAPTURE OF PROTONS BY F^{19} AT A BOMBARDING ENERGY OF 669 keV.

J.V.Kane, R.E.Pixley and D.H.Wilkinson.

Phys. Rev., Vol. 120, No. 3, 952-7 (Nov. 1, 1960).

The ground-state transition from the 13.51 MeV state of Ne^{20} formed by bombarding fluorine with protons of 669 keV is anomalously weak. This is interesting because the 13.51 MeV state has a large reduced width for proton emission to the ground state of F^{19} and a large M1 width for radiation to the first excited (1.63 MeV) state of Ne^{20}. A simple explanation would be that the ground state of Ne^{20} is close to $(2s_{1/2})^4$. The ground-state radiation is sought and found using a 3 × 3 in. NaI(Tl) crystal. The radiative width is approximately 1.0×10^{-2} eV corresponding to $|M|^2 \sim 2 \times 10^{-4}$. The 13.51 MeV state is found also to radiate to the 4.97 MeV state with a width of approximately 0.24 eV. The 4.97 MeV state itself chiefly cascades via the first excited state: an upper limit on the relative strength of the ground-state transition is 0.07.

539.17

20443

ANGULAR DISTRIBUTIONS OF THE REACTION $F^{19}(p,\alpha)O^{16}$ AT 8.0 ~ 14.2 MeV.

H.Ogata.

J. Phys. Soc. Japan, Vol. 14, No. 6, 707-13 (June, 1959).

Alpha-particles from the reaction resulting in the ground state of O^{16} were measured, making use of a proportional counter method. The excitation curve was measured at a laboratory angle of 50°

from 12.9 to 14.1 MeV. The curve changes smoothly with incident proton energy. The angular distributions of the alpha-particles were measured at 14.2, 13.5, 13.0, 12.0, 11.0, 10.0, 9.0, and 8.0 MeV, which can be qualitatively explained by the simple triton pickup theory. Although fairly good agreement with the theory can be seen at 14.2, 13.5 and 9.0 MeV, the angular distributions for the other energies deviate from the theory to some extent. The deviation is generally larger for backward angles and especially at 11.0 and 8.0 MeV striking backward peaks are observed. It is considered that for detailed explanation of the results, refinement of the theory or introduction of other processes of the reaction or both are required.

539.17 : 539.14

20444 ALPHA-PARTICLES FROM THE REACTION $^7Li(p,\gamma)^8Be^*(\alpha)^4He$. D.S.Gemmell.

Austral. J. Phys., Vol. 13, No. 2, 116-19 (June, 1960).

The α-particle spectrum from the reaction $Li^7(p,\gamma)Be^{8*}(\alpha)He^4$ was determined in coincidence with γ-rays The results indicated that, apart from the broad 2.9 MeV level of Be^8, there were no additional levels between the ground state and 7 MeV with intensities greater than 3% of the 2.9 MeV level. It was shown that the shape of the 2.9 MeV level can be fitted satisfactorily by a dispersion formula if a large value for the reduced width of the level is assumed.

539.17 : 539.16

COMPARISON OF Po^{210} ALPHA-PARTICLE ENERGY WITH THE $Li^7(p,n)Be^7$ REACTION THRESHOLD ENERGY. See Abstr. 20378

539.17

20445 RADIATIVE PROTON CAPTURE IN Ni^{58}.

J.H.Carver and G.A.Jones.

Nuclear Phys., Vol. 19, No. 2, 184-98 (Oct. (1), 1960).

The resonance structure of the reaction $Ni^{58}(p,\gamma)Cu^{59}$ was studied by measuring the positron activity of 81 sec Cu^{59}. There were observed 153 new resonances for proton energies between 1.8 and 4.3 MeV. The results can be fitted to a level spacing formula of the form $D(U) = 3.8 \times 10^4 U^2 \exp\{-2\sqrt{5U}\}$ keV (U is in MeV). The nuclear temperature, and hence the slope of the D(U) curve, is in agreement with Cameron's semi-empirical formula which, however, underestimates the absolute spacings by a factor $\cong 15$. The data are interpreted as giving the spacings of levels of all spins. The spacings of the $\frac{3}{2}^+$ and $\frac{5}{2}^+$ states of Cu^{59} are known from previous proton inelastic scattering measurements and combining the two sets of data determines the moment of inertia for Cu^{59} as 0.35 ± 0.12 of the rigid body value. The total radiation widths $g\Gamma_\gamma$ have been determined for the levels with excitations U = 5 to 7.5 MeV and the average value $\overline{g\Gamma_\gamma}(U)$ is found to increase systematically with U. The photon strength function $\overline{g\Gamma_\gamma}(U)/\overline{D}(U)$ also increases with U. The shape, but not the absolute value, of the strength function is correctly given by a statistical calculation in which the radiative probability is determined from photodisintegration data. After removing the average energy dependence the frequency distribution of the total radiation widths $g\Gamma_\gamma/\overline{g\Gamma_\gamma}$ is found to be χ-squared with (2.9 ± 0.6) degrees of freedom. This is consistent with the Porter–Thomas theory since only a few partial radiation widths comprise the bulk of the total radiation width.

539.17 : 539.12

$T^3(p,n)He^3$ THRESHOLD ENERGY. See Abstr. 20246

539.17

20446 EXCITATION FUNCTIONS FOR (p,n) REACTIONS WITH TITANIUM, VANADIUM, CHROMIUM, IRON AND NICKEL UP TO Ep = 14 MeV. S.Tanaka and M.Furukawa.

J. Phys. Soc. Japan, Vol. 14, No. 10, 1269-75 (Oct., 1959).

The absolute (p,n) cross-sections on Ti^{47}, Ti^{48}, V^{51}, Cr^{52}, Fe^{56}, Fe^{57}, Ni^{61} and Ni^{64} were measured by the activation method at proton energies up to 14 MeV. The experimental results were compared with predictions based on the statistical model in terms of $\sigma(p,n)/\sigma_{total}$, and it was shown that the predictions based on this simple model are not necessarily in disagreement with the experiments.

539.17 : 539.12

20447 INVESTIGATION OF MEDIUM AND HEAVY NUCLEI BY QUASI-FREE PROTON–PROTON SCATTERING.

G.Jacob and T.A.J.Maris.

Phys. Rev. Letters, Vol. 5, No. 5, 210-11 (Sept. 1, 1960).

Considers nearly coplanar processes, with both scattering angles near 45°. Argues that the dominant contributions come fro "pole caps" of the nucleus, at the ends of the symmetry axis, givi interference patterns. Multiple scattering gives a slowly varying background. R.J.N.Philli

539.1

20448 THEORETICAL STUDY OF TRIPLET SCATTERING AND DEPOLARIZATION PARAMETERS IN ELASTIC PROTON-NUCLEUS COLLISIONS. P.Loncke.

C.R. Acad. Sci. (Paris), Vol. 251, No. 4, 544-6 (July 25, 1960). In French.

The parameters D, A and R of Wolfenstein are calculated fo proton-nucleus elastic scattering at 156 and 310 MeV. The calculations are limited to small angles where the impulse approximati is valid. It is shown that in this case D, A and R are independent of the spin of the target nucleus as has already been shown to be th case for polarization (see Abstr. 5739 of 1960). The results are i good agreement with experiment. J.D.Dowe

539.

20449 THE DIPOLE GIANT RESONANCE IN THE HIGH ENERGY PROTON SCATTERING.

M.Kawai and T.Terasawa.

Progr. theor. Phys., Vol. 22, No. 4, 513-25 (Oct., 1959).

The characteristic peaks in the energy spectra of high-energy (p,p') scattering accompanied by residual excitation of 20 MeV, experimentally observed by Tyren and Maris (Nuclear Phys., 1957 are analysed in terms of the Coulomb excitation. It is shown that the Born approximation the cross-section for this process can be directly connected with the absorption cross-section of electric dipole γ-rays, without referring to any special nuclear model. Us the known photonuclear cross-sections, (p,p') energy spectra are calculated and are compared with experiment. Shapes of the energ spectra are reasonably well reproduced by the calculation. Also t absolute magnitude of the calculated cross-sections are in agreem with the observed ones as far as the order of magnitude is concerned. On closer examination, however, it seems that the former may be smaller than the latter by a factor of 2 to 4. Several discussions are given.

539.1

20450 ANGULAR DISTRIBUTIONS OF 6.8 MeV PROTONS ELASTICALLY SCATTERED ON CHROMIUM, NICKEL AND COPPER NUCLIDES.

A.K.Val'ter, I.I.Zalyubovskii, A.P. Klucharyev, M.V. Pasechnik, N.N.Pucherov and V.I.Chirko.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1419-23 (1960). In Russian.

The angular distributions of 6.8 MeV protons elastically scattered on $Cr^{52,53}$, $Ni^{58,60,62}$ and $Cu^{63,65}$ nuclides were investigate Appreciable differences in the behaviour of the differential cross-sections were found between isotopes of a given element. The results indicate that in scattering studies allowance should be mad for the individual features of the nuclei.

539.1

20451 POLARIZATION OF PROTONS SCATTERED ON O^{16}.

K.V.Karadzhev and V.I.Man'ko.

Zh. eksper.teor. Fiz., Vol. 39, No. 2(8), 416-17 (Aug., 1960). In Russian.

The polarization of 3-4.5 MeV protons elastically scattered on O^{16} is calculated for three angles: 60, 90 and 120°. It is shown that the polarization is very sensitive to the choice of the level parameters of the F^{17} nucleus.

539.1

20452 SCATTERING OF PROTONS BY SILICON AND SULPHUR. Y.Oda, M.Takeda, C.Hu and S.Kato.

J. Phys. Soc. Japan, Vol. 14, No. 10, 1255-60 (Oct., 1959).

The angular distributions of protons in elastic and inelastic scattering by Si and S were studied at bombarding energies from 4.95 to 5.45 MeV at 100 keV intervals. The angular distribution of proton groups from the reaction $Si^{28}(p,p')Si^{28*}$ (Q = −1.78 MeV) is nearly symmetric about 90° for any bombarding energy but the tota cross-section changes appreciably with the incident energy. On th other hand, the results for the reaction $S^{32}(p,p')S^{32*}$ (Q = −2.24 Me show large variation with the energy in both angular distribution a total cross-section. The energy dependence of the angular distribu tion of protons elastically scattered by silicon is found to be great than for sulphur in the energy region studied.

539.17

)453 ELASTIC AND INELASTIC SCATTERINGS OF PROTONS FROM Ti, Cr, Ni, Zn, and O AT 8 TO 14 MeV.
C u, K.Kikuchi, S.Kobayashi, K.Matsuda, Y.Nagahara, Y.Oda,
N akano, M.Takeda and T.Yamazaki.
J hys. Soc. Japan, Vol. 14, No. 7, 861-9 (July, 1959).

The elastic and inelastic (leading to the first excited states of t get nuclei) scatterings of protons by medium weight nuclei (Ti, C Ni, and Zn) were studied by observing the dependence of their a ılar distributions on bombarding energies from 8 MeV to 1 MeV. The angular distributions of protons elastically scattered f m oxygen were also measured in the same energy range. There a appreciable regularities in the elastic scatterings by medium v ght nuclei as regards the dependence of their angular distribu- t s on the bombarding energy and on the atomic number except in t case of the bombarding energy of 8 MeV. The elastic scatte- gs from oxygen show an anomalous behaviour at energies about leV. The angular distributions of protons inelastically scattered f n medium weight nuclei can be fitted by the predictions of the ect interaction theory with Born approximation at about 14 MeV, at the lower bombarding energies they seem not to do so, ough they have prominent forward peaks. The distorted Born roximation or the admixture of amplitudes due to compound cess seems to be necessary to explain the angular distributions. ddition, it is found that the yield of the inelastic scattering ies appreciably with the bombarding energy. For an Ni target, dependence of the yield of the inelastic scattering leading to the st excited state on the bombarding energy was measured in ail by changing the incident proton energy at intervals of about keV. It was recognized that there were resonance-like behavi- s with spacing of about several hundred keV.

539.17 : 539.14

20454 STRIPPING REACTIONS AND THE STRUCTURE OF LIGHT AND INTERMEDIATE NUCLEI.
.H.Macfarlane and J.B.French.
v. mod. Phys., Vol. 32, No. 3, 567-691 (July, 1960).

The reduced width for the emission of a single nucleon in a ansition between two specific nuclear states is expressed as $= S\theta_0^2$ where the "spectroscopic factor" S is essentially the overlap tween the initial and final nuclear states and θ_0^2 is the single rticle reduced width. There is given an extensive table of npirical reduced widths for deuteron—nucleon and deuteron— iton stripping reactions with $6 \leq A \leq 68$. These were extracted om experimental cross-sections using Born-approximation, the fficulties of which are circumvented by considering θ_0^2 to be an npirical parameter. A symbolic notation is then developed in der to facilitate the calculation of S in the case of various species shell-model and also the rotational and weak coupling collective odels. This is independent of the earlier use of the Born- proximation. Using this formalism the empirical reduced widths bulated earlier are analysed to give information about: (1) Nuclear ates e.g. their spin, interaction matrix elements, nuclear models, ngle-particle levels and stripping reactions, single-hole states nd pick-up reactions. (2) Mechanism of stripping reactions. θ_0^2 as function of projectile energy and Q-value is found to vary smoothly nd so indicates that the procedure involving the Born-approximation reliable. Finally some experiments are suggested, which would rther this line of study. A.M.Green

539.17 : 539.14

20455 MEASUREMENTS OF n–γ COINCIDENCES IN THE REACTION ^{10}B(d,nγ)^{11}C.
A.McDonell, D.G.Sargood, J.R.Moroney and J.R.Prescott.
ustral. J. Phys., Vol. 13, No. 2, 99-115 (June, 1960).

The energies of some neutron groups leading to low excited ates of C^{11} in the reaction B^{10}(d,nγ)C^{11} were measured. These led values of 4.3 ± 0.3 MeV and 6.53 ± 0.02 MeV for the energies of e second and fourth excited states respectively. Gamma-ray pectra were studied in coincidence with different neutron groups. round-state transitions were observed from the second, third and urth excited states, together with cascade decays of the fourth xcited state through each of the second and third. Deductions from ese γ-ray spectra considerably reduce the number of spin ossibilities which were found for these levels by other workers.

539.17

20456 PROTONS FROM DEUTERON BOMBARDMENT OF Be^7.
R.W.Kavanagh.
Nuclear Phys., Vol. 18, No. 3, 492-501 (Sept. (1), 1960).

Protons from the reaction Be^7(d,p)Be^8 leading to Be^8 excitations up to 11 MeV were examined with a NaI:Tl scintillation spectrometer. No groups attributable to Be^8 were observed except those corresponding to the ground state (p$_0$) and first excited state (p$_1$), along with a continuum extending to over 11 MeV excitation. Resonances were found at bombarding energies of 0.900 ± 0.025 (p$_0$ and p$_1$) and 1.475 ± 0.010 MeV (p$_1$ only) with centre-of-mass widths 120 ± 40 and 71 ± 8 keV, respectively, corresponding to states in B^9 at 17.19 and 17.63 MeV. The excitation energy and width of the first excited state of Be^8 were $E_X = 2.90 \pm 0.06$ and $\Gamma_{cm} = 1.53 \pm 0.04$ MeV. The reduced width of this state and the α—α interaction radius extracted from a single-level analysis were compared with those found in He^4(α,α) and B^{10}(d,α) reactions.

539.17

20457 ANGULAR DISTRIBUTIONS OF THE Be^9(d,n)B^{10} NEUTRONS. R.Bardes and G.E.Owen.
Phys. Rev., Vol. 120, No. 4, 1369-74 (Nov. 15, 1960).

The angular distributions of neutrons to the ground state and to the first excited state of B^{10} in the reaction Be^9(d,n)B^{10} were studied at incident deuteron energies of 1.41, 1.88 and 2.35 MeV. A proton recoil spectrometer utilizing a xenon gas scintillation trigger was developed to study this problem. This spectrometer operated with a resolution of the order of 7% at the neutron energies involved in this reaction. The analysis of the data in terms of a direct interaction mechanism indicates that the results are consistent with an interpretation which indicates that the majority of the neutrons emitted at bombarding energies below the Coulomb barrier originate in the Be^9 target nucleus.

539.17

20458 ANGULAR DISTRIBUTION OF PROTONS FROM THE C^{12}(d,p)C^{13} REACTION WITH 5—13 MeV DEUTERONS.
N.I.Zaika, O.F.Nemets and M.A.Tserineo.
Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 3-6 (July, 1960).
In Russian.

The angular distributions corresponding to the ground state of C^{13} were measured for five deuteron energies in the interval 5—13 MeV, and also of protons corresponding to the three lower excited states for deuteron energies of 13.3 and 12.1 MeV. The parities and possible spins of the states were determined. It is shown that with decrease of the energy, non-stripping reactions become more important.

539.17

20459 POLARIZATION OF PROTONS FROM C^{12}(d,p)C^{13} REACTION IN FUNCTION OF THE INCIDENT DEUTERON ENERGY. S.D.Ćirilov and M.K.Jurić.
Bull. Inst. Nuclear Sci."Boris Kidrich", Vol. 9, 39-41 (March, 1959).

The polarization was measured as a function of energy of the incident deuteron in the vicinity of the resonant energy at 1.16 MeV. It was found that the polarization varies rapidly with bombarding energy and at the peak of the resonance the polarization was equal to zero.

539.17 : 539.14

Ne^{20,22}(d,p)Ne^{21,23} REACTIONS. See Abstr. 20351

539.17

20460 ABSOLUTE DETERMINATION OF THE O^{16}(d,n)F^{17} THRESHOLD ENERGY.
R.O.Bondelid, J.W.Butler and C.A.Kennedy.
Phys. Rev., Vol. 120, No. 3, 889-90 (Nov. 1, 1960).

The threshold energy of the O^{16}(d,n)F^{17} reaction was measured in an absolute manner with a 2-meter radius electrostatic analyser. The value, obtained from the intercept of the plot of (net neutron counts)$^{2/3}$ as a function of bombarding energy, is 1829.2 ± 0.6 keV. This threshold energy gives a reaction Q value of −1.6246 ± ± 0.0005 MeV, a F^{17} mass of 17.007 499 0 ± 0.000 003 2 a.m.u., and a mass excess of 6.9828 ± 0.0030 MeV.

539.17

20461 ELASTIC SCATTERING OF 19.5 MeV DEUTERONS IN CHLOROFORM. J.Aguilar and M.C.Altés.
An. Real Soc. Espan. Fis. Quim., Vol. 55(A), No. 9-10, 345-50 (Sept.-Oct., 1959). In Spanish.

The scattering of deuterons by chlorine was studied at an energy of 19.5 MeV using nuclear emulsions. The angular distribution of the deuterons was compared with the Rutherford formula and an approximate value obtained for the radius of the interaction using the diffraction formula for a strongly absorbing disc.

539.17

20462 THE REACTION $B^{11}(t,p_0)B^{13}$ AND THE MASS EXCESS OF B^{13}.

J.Muto, F.de S.Barros and A.A.Jaffe.

Proc. Phys. Soc., Vol. 75, Pt 6, 929-31 (June, 1960).

The reaction was observed by bombarding a thin target of natural boron on a carbon backing by 5.5 MeV tritons accelerated in a van de Graaff generator and measuring the energy of the ground-state proton group at various angles using a magnetic spectrograph. No groups corresponding to higher levels in B^{13} were observed. In order to calculate the Q value of the reaction, the energy of the triton beam was determined from the energies of the ground-state groups resulting from the following reactions: $C^{12}(t,p_0)C^{14}$, $C^{12}(t,d_0)C^{13}$, $C^{12}(t,\alpha_0)B^{11}$ and $O^{16}(t,d_0)O^{17}$. The energy of elastically scattered deuterons from a beam contamination of HD was also measured and used for this purpose. The ground-state Q value of the reaction $B^{11}(t,p)B^{13}$ was found to be -0.233 ± 0.004 MeV, giving a mass excess for the B^{13} atom of 20.397 ± 0.009 MeV. The angular distribution of the ground-state protons in the range 12.5° to 68.6° in the centre-of-mass system was measured and is consistent with the stripping of two neutrons from the triton with antiparallel spins leading to a ground-state spin $3/2^-$ for B^{13}. R.E.Meads

539.17 : 539.14

$O^{16}(t,\alpha)N^{17}$, $O^{16}(t,p)O^{18}$ AND $O^{18}(t,p)O^{20}$ REACTIONS. See Abstr. 20350

539.17

20463 THE SCATTERING OF 28.5 MeV ^{3}He PARTICLES BY ^{12}C, ^{20}Ne AND ^{40}A NUCLEI.

J.Aguilar, W.E.Burcham, J.B.A.England, A.García, P.E.Hodgson, P.V.March, J.S.C.McKee, E.M.Mosinger and W.T.Toner.

Proc. Roy. Soc. A, Vol. 257, 13-21 (Aug. 23, 1960).

Differential cross-sections for the elastic and inelastic scattering of 28.5 MeV He^3 particles by the nuclei C^{12}, Ne^{20} and A^{40} were measured by means of a photographic technique. The $C^{12}(He^3,\alpha)$ reaction was also observed. The elastic scattering distributions were analysed in terms of an optical model.

539.17

20464 SINGLE AND MULTIPLE STRIPPING OF α PARTICLES.

M.el Nadi.

Phys. Rev., Vol. 120, No. 4, 1360-9 (Nov. 15, 1960).

Assuming the stripping process to take place mainly at the nuclear surface, expressions are derived for the differential cross-sections for the processes in which one, two, or three nucleons are stripped from an incident α-particle by the target nucleus. Comparison between the derived formulae and experimental data was carried out for the (He^3,p) and (α,p) reactions and shows fairly good agreement.

539.17

20465 ANGULAR CORRELATION STUDIES OF THE $Be^9(\alpha,n\gamma)C^{12}$ REACTION.

J.B.Garg, J.M.Calvert and N.H.Gale.

Nuclear Phys., Vol. 19, No. 3, 264-79 (Oct. (3), 1960).

Several angular distributions and (n,γ) correlations of the neutron group corresponding to the 4.43 MeV level of C^{12}, produced in the reaction $Be^9(\alpha,n\gamma)C^{12}$, were measured using time-of-flight techniques. Bombarding energies of 3.35 MeV and 5.10 MeV were used. Results were analysed in terms of direct-interaction mechanisms. The angular distributions showed forward peaking and could be fitted reasonably well by Butler's theory assuming contributions from $l = 1$ and $l = 3$ but required a rather large value of the radius parameter. Angular correlation measurements were carried out in the reaction plane for neutrons emitted at 10°, 20° and 75° to the direction of the incident beam at energies of 3.35 MeV and 5.10 MeV. These were fitted by a sum of even-order Legendre polynomials. The correlations showed marked changes both with neutron angle and bombarding energy, but the symmetry axis was in most cases not very far from the direction of momentum transfer. These results would suggest interference either from different reaction mechanisms, different l-values or both.

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20466 ANGULAR DISTRIBUTIONS OF PROTONS FROM THE REACTION $^{12}C(\alpha,p)^{15}N$.

I.Nonaka, H.Yamaguchi, T.Mikumo, I.Umeda, T.Tabata and S.Hitaka.

J. Phys. Soc. Japan, Vol. 14, No. 10, 1260-8 (Oct., 1959)

Angular distributions of protons corresponding to the ground state transition from the reaction $C^{12}(\alpha,p)N^{15}$ were measured at twelve α-particle energies between 25 and 39 MeV. Each angular distribution shows pronounced diffraction-like patterns, but there apparently exists a systematic shift in the shape and magnitude o angular distributions as the energy changes. At lower energies a sharp rise in the backward angles is observed, but at higher ener this does not occur. Angular distributions of protons correspondi to some excited-state transitions were also measured at 34.6 Me

539

20467 THE REACTION OF $^7Li(\alpha,\gamma)^{11}B$.

G.A.Jones, C.M.P.Johnson and D.H.Wilkinson.

Phil. Mag (Eighth Ser.), Vol. 4, 796-814 (July, 1959).

The gamma rays following excitation by the $Li^7(\alpha,\gamma)B^{11}$ reaction of levels in B^{11} at 9.28, 9.19 and 8.93 MeV were studied with sodium iodide scintillation counters and a scintillation pair spectrometer. The decay schemes of these levels were elucidate and angular distributions of some of the gamma rays were measured. From these data, and a consideration of the reaction widths of the levels in B^{11}, assignments of spins and parities wer made for some of these levels. In particular it was established that the characteristics of the 4.46 and 9.28 MeV levels in B^{11} are $\frac{5}{2}-$ and $\frac{5}{2}+$ respectively, and that the M1 radiation from the 4.46 M level is mixed with a small proportion of E2 radiation.

539

20469 ALPHA-PARTICLE EXCITATION OF QUADRUPOLE AND OCTUPOLE SURFACE MODES IN Ti, Fe, Ni, Zn AND Sr.

D.K.McDaniels, J.S.Blair, S.W.Chen and G.W.Farwell.

Nuclear Phys., Vol. 17, No. 4, 614-40 (July (2), 1960).

Angular distributions were obtained for elastic and inelastic scattering of 41 MeV alpha particles by Ti^{48}, Fe, Ni, Zn, Zn^{64} and Sr. In all targets excitation by inelastic scattering is strongest fo the low-lying 2^+ levels, usually described in terms of quadrupole surface vibrations, and for the "anomalous" levels of somewhat higher excitation. The results for both elastic and inelastic scatte ring are analysed in terms of a strong absorption diffraction scatt ring model. Parameters associated with collective interpretation of both types of levels are estimated and compared with values of the corresponding quantities derived from Coulomb excitation and electron scattering experiments. Reasonable agreement is obtaine in the quadrupole excitation analyses. Strong support is given for 3^- assignments for the anomalous levels and for their interpretati in terms of surface octupole vibrations.

539.

20468 SCATTERING OF 38 MeV ALPHA-PARTICLES BY C

J.Catalá, L.Miralles and J.Aguilar.

An. Real Soc. Espan. Fis. Quim., Vol. 55(A), No. 9-10, 241-4 (Sept.-Oct., 1959). In Spanish.

The elastic and inelastic scattering differential cross-section was studied at an energy of 38 MeV using nuclear emulsions. For the elastic process, an approximate value for the radius of the inter action is obtained, using the diffraction formula for a strongly absorbing disc.

539.

20470 A PRELIMINARY STUDY OF NUCLEAR INTERACTI INDUCED BY 200 MeV Ne^{20} IONS IN NUCLEAR TRAC EMULSIONS.

R.Pfohl, C.Gegauff and J.Lonchamp.

C.R. Acad. Sci. (Paris), Vol. 251, No. 5, 712-14 (Aug. 1, 1960). In French.

Reports preliminary measurements on G5 emulsions irradiat with 200 MeV Ne^{20} ions. Values of effective reaction cross-sections a function of incident energy, prong distribution and differential cross-sections are given. R.H.Thom

539.

20471 HEAVY-ION COULOMB EXCITATION OF NUCLEI ACCOMPANIED BY RADIATION OF γ-QUANTA.

B.N.Kalinkin.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1541-3 (1960). In Russian.

Considers Coulomb excitation of high single-nucleon levels i the nucleus by bombardment with heavy ions possessing energies sm than that of the Coulomb barrier. The magnitude of the cross-sections indicates that an experimental proof of the existence of such levels may be feasible.

539

20472 DETERMINATION OF THE YIELD OF PHOTO-NEUTRONS EMITTED BY LEAD UNDER THE ACTIO OF 10.5-20.5 MeV ELECTRONS. (THICK ABSORBER METHOD).

V.M.Grizhko, D.I.Sikora, V.A.Shkoda-Ul'yanov, A.D.Abramenkov,

Shramenko and A.N.Fisun.
eksper. teor. Fiz., Vol. 38, No. 5, 1370-3 (1960). In Russian.

The yield of photoneutrons from a thick lead plate on total orption of a monochromatic beam was measured. The experi- tal curve was compared with the theoretical curves computed aid of the Belen'kii–Tamm equilibrium spectra. The absolute gy calibration of the monochromator was based on the shold of the (γ,n)-reaction in oxygen and carbon.

539.17

0473 ELECTRODISINTEGRATION OF Ta AND Au NUCLEI.

W.C.Barber and T.Wiedling.
lear Phys., Vol. 18, No. 4, 575-86 (Sept. (2), 1960).

Yield curves were measured for the production of 5.6 day Au^{196} 30 sec Au^{195} from Au^{197}, and of 8.1 hour Ta^{180}, 2.1 hour Ta^{178}, 9.3 min Ta^{178} from Ta^{181}, in foil stacks which were bombarded lectrons. The results were analysed to compare the yields ulting from the direct effect of the electrons with those resulting n bremsstrahlung from the electrons. The comparison shows direct effect is relatively larger than is predicted by existing ories of electrodisintegration if the transitions being excited entirely electric dipole. Agreement with the theory can be ined if electric monopole and quadrupole transitions are also umed present. The theory, however, makes use of approximations ch are probably not valid for nuclei with high Z. If there is a nopole resonance in the region of 25-40 MeV excitation, its tribution to the 2n and 3n reactions is less than 30% of the contri- ons of higher multipoles to these reactions.

539.17

20474 INELASTIC SCATTERING OF ELECTRONS ON O^{16} PRODUCING EXCITATION OF THE GIANT RESONANCE.

ishop.
. Acad. Sci. (Paris), Vol. 251, No. 5, 697-9 (Aug. 1, 1960).
rench.

Describes the results of measurements on the scattering m O^{16} of 60-150 MeV electrons. A structure in the inelastic ttering is found, corresponding to resonances calculated by iot and Flowers. R.H.Thomas

539.17

20475 INTEGRATED CROSS SECTIONS FOR THE REACTIONS A$^{40}(\gamma,p)$ AND A$^{40}(\gamma,np)$.

G.Dosch, K.H.Lindenberger and P.Brix.
clear Phys., Vol. 18, No. 4, 615-23 (Sept. (2), 1960).

The (γ,p) and (γ,np) reactions in A^{40} were re-examined with MeV bremsstrahlung by measuring the product chlorine radio- tivities. Details of the sample preparation are given. Yields lative to C$^{12}(\gamma,n)$ and Cu$^{63}(\gamma,n)$ were determined by β-counting. om additional measurements with a lead absorber in the beam, following cross-sections integrated to 33 MeV were deduced: 0 ± 15) MeV·mb for (γ,p) and (25 ± 10) MeV·mb for (γ,np). This cludes definitely the anomalously high cross-section values ported in the literature. An approximate yield for the $(\gamma,2p)$ ocess is also given.

539.17

20476 PHOTONEUTRON CROSS-SECTIONS FOR Ag^{107}, Mo^{92} AND Zr^{90}.

Mutsuro, Y.Ohnuki, K.Sato and M.Kimura.
Phys. Soc. Japan, Vol. 14, No. 12, 1649-53 (Dec., 1959).

Photoneutron cross-sections and yield curves were obtained the residual activity method. Threshold energies were obtained 9.35 ± 0.1, 9.15 ± 0.1, 12.38 ± 0.1 and 12.3 ± 0.1 MeV for ^{107,109}, Mo^{92} and Zr^{90} respectively. The energy for the maximum oss-section was obtained as 14.5 MeV for Ag^{107}, 16.5 MeV for ^{92} and 17 MeV for Zr^{90}. The giant resonance widths were easured about 5.2, 2.7 and 2.9 MeV respectively. Intrinsic quad- pole moment determined from above data was (1.9 ± 0.7) × 10^{-24} cm^2 for Ag^{107}.

539.17

20477 POSITION OF THE GIANT RESONANCE IN THE DIPOLE ABSORPTION OF γ-QUANTA BY ATOMIC CLEI.

V.G.Neudachin, V.G.Shevchenko and N.P.Yudin.
. eksper. teor. Fiz., Vol. 39, No. 1(7), 108-11 (July, 1960).
Russian.

The giant resonance curves for Ca^{40}, V^{51}, Ni^{58}, Cu$^{63\ 65}$ are lculated on the basis of the shell model. It is shown that, if ectroscopic data on the lower nuclei levels are employed, the ell theory calculations yield the correct position of the giant sonance.

539.17

20478 PHOTONEUTRON CROSS SECTIONS OF COBALT AND MANGANESE.

P.A.Flournoy, R.S.Tickle and W.D.Whitehead.
Phys. Rev., Vol. 120, No. 4, 1424-8 (Nov. 15, 1960).

The total photoneutron yields of Mn^{55} and Co^{59} were measured from threshold to approximately 30 MeV. Analysis of these data using the Leiss–Penfold matrix indicates that the cross-sections for both elements show a splitting in the giant resonance region in accord with the predictions of the classical hydrodynamic model. The Mn^{55} peaks occur at energies of 16.8 ± 0.25 and 19.75 ± 0.25 MeV corresponding to cross-sections of 90 and 77 mb, respectively. Co^{59} maxima occur at 16.75 ± 0.25 and 18.75 ± 0.25 MeV with cross-sections of 109 and 92 mb. The cross-sections $\sigma(\gamma,n) + \sigma(\gamma,2n) + \sigma(\gamma,np) + \cdots$ integrated to 25 MeV are 627 MeV-mb for Mn^{55} and 709 MeV-mb for Co^{59}. Breit–Wigner resonance lines were fitted to both cross-sections and the intrinsic quadrupole moments determined from these fits are +0.78 ± 0.10 barn for manganese and +0.76 ± 0.11 barn for cobalt.

539.17

20479 ABSOLUTE CROSS-SECTIONS OF THE (γ,n) REACTION FOR Cu^{63}, Zn^{64} AND Ag^{109}.

T.Nakamura, K.Takamatsu, K.Fukunaga, M.Yata and S.Yasumi.
J. Phys. Soc. Japan, Vol. 14, No. 6, 693-8 (June, 1959).

The photonuclear reaction cross-section of Cu$^{63}(\gamma,n)$Cu^{62} has been frequently used as the standard for the (γ,n) reactions, but the measured values by many workers do not agree with one another and can be roughly divided into two groups, namely, about 100 mb group and about 50 mb group. It appears that the former group contains the values obtained mainly by measurements using bremsstrahlung, while the latter those obtained mainly with Li-p γ-rays. An attempt was made to re-determine the (γ,n) cross-section for copper, zinc and silver by Li-p γ-rays. Absolute measurement of γ-quanta was performed by Hough's method, and reaction yields were determined by the activation method in which the absolute numbers of activated nuclei in samples were determined by measuring the β-ray with a 4π-proportional counter and applying the "method of extrapolation". The cross-sections of Cu^{63}, Zn^{64} and Ag^{109} for 17.6 MeV γ-rays were found to be 42.5 mb ± 15%, 23.3 mb ± 18% and 61.5 mb ± 16% respectively. Experimental cross-sections so far obtained by many workers are given in a table and some discussions are given.

539.17

20480 THE Mg$^{24}(\gamma,n)$Mg^{23} REACTION.

J.D.King and W.J.McDonald.
Nuclear Phys., Vol. 19, No. 1, 94-100 (Sept. (3), 1960).

The Mg$^{24}(\gamma,n)$Mg^{23} reaction was studied by irradiating a magnesium sample in the X-ray beam of a 25 MeV betatron and measuring the Mg^{23} positron decay by coincidence detection of the annihilation radiation. The cross-section had a small peak at 17.2 MeV with the giant resonance appearing at 19.2 MeV; there was a pronounced high-energy tail. These results were compared with recent investigations of the Na$^{23}(p,\gamma)$Mg^{24} inverse photonuclear reaction. Both cross-sections showed a small peak below the giant resonance region. An attempt was made to interpret the cross-section shapes in terms of the deformation of the Mg^{24} nucleus, but the results were inconclusive.

539.17

20481 APPLICATION OF THE STATISTICAL MODEL TO MULTIPLE PHOTONUCLEAR PROCESSES.

S.Costa.
R.C. Accad. Naz. Lincei, Vol. 28, No. 2, 179-82 (Feb., 1960).
In Italian.

A comparison of theory with experiment for various photoreactions on S^{32} in the range 24-30 MeV. R.J.N.Phillips

539.17

20482 CONTRIBUTION TO THE THEORY OF OPTICAL ANISOTROPY OF ATOMIC NUCLEI.

A.M.Baldin and S.F.Semenko.
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 434-7 (Aug., 1960). In Russian.

Elastic scattering of γ-quanta on oriented nuclei is considered. The possibility of an experimental study of nuclear optical anisotropy parameters, including the vector electric dipole polarizability of nuclei, is discussed.

539.17

20483 NEUTRON SPECTROSCOPY WITH NUCLEAR EXPLOSIONS. D.J.Hughes.

Nucleonics, Vol. 18, No. 7, 54-8 (July, 1960).

Nuclear explosions could be used as neutron sources for nuclear physics measurements of high resolution. Possible experiments and suitable apparatus are discussed and it is shown that the resolution attainable is many times better than that with achieved with pulsed sources or neutron choppers. R.D.Smith

539.17

20484 NUCLEAR DISINTEGRATIONS PRODUCED BY 900 MeV NEUTRONS. W.T.Morton and B.A.Munir.

Phil. Mag. (Eighth Ser.), Vol. 4, 933-7 (Aug., 1959).

Ilford G5 nuclear research emulsions were irradiated with neutrons with an energy of the order of 900 MeV. The characteristics of the disintegrations observed in the heavy nuclei of the emulsion are given and compared with the corresponding results for 950 MeV protons.

539.17 : 523.877

20485 CREATION OF THE HEAVY ELEMENTS BY NEUTRON CAPTURE ON A FAST TIME SCALE. P.Fong.

Phys. Rev., Vol. 120, No. 4, 1388-93 (Nov. 15, 1960).

The mathematical problem concerning the creation of the heavy elements by neutron capture on a fast time scale involves the solution of more than a thousand simultaneous differential equations. This set of equations is solved by replacing them with a mathematical equivalent — a single partial differential equation which turns out to assume the form of the equation of continuity. The stream lines of the analogous hydrodynamical problem are determined, from which the problem of nucleogenesis may be solved once the initial condition is given. By assuming a neutron capture mean lifetime of about 0.1 sec for all nonmagic-number nuclides and by making use of the fact that the neutron magic-number nuclides have smaller neutron-capture cross-sections, the position, width, and height of the abundance peaks at Br, Xe, and Pt may be determined; these agree reasonably well with the experimental results.

539.17

20486 NEUTRON YIELD FROM 14 MeV NON-ELASTIC INTERACTIONS AND THE (n,2n) CROSS-SECTION.

P.P.Lebedev, Yu.A.Zisin, Yu.S.Klintsov and B.D.Stsiborskii.

Atomnaya Energiya, Vol. 5, 522 (1958). In Russian. English translation in: Reactor Science, Vol. 11, No. 1, 39-42 (Nov., 1959).

The number of neutrons η produced per non-elastic interaction between neutrons and nuclei was measured for a range of elements having natural isotopic composition (Fe, Cu, Mo, Cd, Sn, Sb, Hg, Pb, Bi, U). The measurements were made by determining the relative change in the total neutron flux and the attenuation of the primary neutron beam in passing through samples of the elements being studied. The non-elastic neutron cross-sections σ_{ne} of these elements were also determined. (n,2n) cross-sections, averaged over the isotopic composition, are calculated for the non-fissionable nuclei using the values of σ_{ne} and η obtained in this work together with the published neutron capture cross-sections.

539.17

20487 NEUTRON CAPTURE CROSS SECTIONS IN THE keV REGION. I. METHODS OF MEASUREMENT AND ANALYSIS. E.G.Bilpuch, L.W.Weston and H.W.Newson.

Ann. Phys. (New York), Vol. 10, No. 4, 455-76 (Aug., 1960).

The relative capture cross-sections in the neutron energy range from 3 to 200 keV for Au^{197}, Pt^{198}, and U^{238} were measured with the beta activation technique. After normalization, the capture cross-sections of Au^{197} and U^{238} were analysed for the p-wave parameters, $(\bar{\Gamma}\gamma/D_0)_p$ and $\bar{\Gamma}_n^{(1)}/D$. For Au^{197} it was found that the relation $(\bar{\Gamma}\gamma/D_0)_p = (\bar{\Gamma}\gamma/D_0)_s$ was consistent with the experimental data. In the case of U^{238}, $(\bar{\Gamma}\gamma/D_0)_p = 2.6(\bar{\Gamma}\gamma/D_0)_s$. This relation can be explained qualitatively by considering parity effects in the shell model. The p-wave strength functions consistent with the experimental data were $\bar{\Gamma}_n^{(1)}/D = 0.33 \times 10^{-4}$ and $\bar{\Gamma}_n^{(1)}/D = 0.7 \times 10^{-4}$ for Au^{197} and U^{238}, respectively. Techniques of measurement and analysis are described.

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20488 NEUTRON CAPTURE CROSS SECTIONS IN THE keV REGION. II. SPIN—ORBIT COUPLING AND THE OPTICAL MODEL.

L.W.Weston, K.K.Seth, E.G.Bilpuch and H.W.Newson.

Ann. Phys. (New York), Vol. 10, No. 4, 477-89 (Aug., 1960).

An intensive study of average neutron capture cross-section of nuclei with $75 \leq A \leq 130$ has been carried out in the neutron energy region 3 to 200 keV, using the activation method. Assumi s-wave parameters within the limits of error specified by low-energy total cross-sections determinations, the data has been analysed for corresponding p-wave parameters: the neutron stre function $\bar{\Gamma}_n^{(1)}/D$ and the γ-ray strength function $\bar{\Gamma}_\gamma/D_0$. It is found that the s-and p-wave γ-ray strength functions are the same with the rather large limits of experimental error for the odd A targe Rh^{103}, Ag^{107}, Ag^{109}, In^{115}, and As^{75}. The even—even isotopes of Pd are more complicated in this respect. The p-wave neutron stren functions $\bar{\Gamma}_n^{(1)}/D$ derived from the analysis of these capture cross sections are found to be in agreement with $\bar{\Gamma}_n^{(1)}/D$ as obtained fro the analysis of neutron total cross-sections. These strength functions exhibit a broad, double-peaked, distribution around A = 100 instead of the single peak predicted by the simple optical model. It is shown that the experimental results may be explaine by the addition of a small spin—orbit part to the optical potential. The parameters of the square well optical potential

$$V\pm = V_0[1 + i\xi + \delta/2\{-1 \pm (2l + 1)\}]$$

which are found to fit the p-wave strength functions best are $V_0 = 41$ MeV, $\xi = 0.02$, $\delta = 0.085$, and $R = 1.45 A^{1/3}$ fermis.

539

20489 STUDY OF THE REACTION $Be(n,2n)2\alpha$. Cao Xuan Chuan.

J. Phys. Radium, Vol. 20, No. 6, 621-3 (June, 1959). In French.

This reaction has been investigated by incorporating Be^9 in nuclear plates. These plates are irradiated with 14 MeV neutron The observation of the two resulting alphas provides a means of i vestigating the excited levels of Be^8; it seems that the reaction go mostly through the 2.9 MeV excited level of Be^8. The cross-secti is estimated as 470 mb with 30% precision. Search for the possib ity of emission of a "di-neutron" gives a negative result.

[illegible]

20490 GAMMA-RAYS FROM THE INTERACTION OF 14 Me NEUTRONS WITH BERYLLIUM.

J.Benveniste, A.C.Mitchell, C.D.Schrader and J.H.Zenger.

Nuclear Phys., Vol. 19, No. 1, 52-61 (Sept. (3), 1960).

The cross-sections for the $Be^9(n,t')Li^{7*} \rightarrow Li^7 + \gamma$(0.477 Me reaction was measured in the vicinity of 14 MeV by detecting the gamma-rays at scattering angles from 30° to 150°. A time-of-fli technique was used to distinguish the gamma-rays from the high neutron background. The cross-section dropped from 20 mb at 13.6 MeV to 10 mb at 14.1 MeV and then rose to 30 mb at 14.7 Me

539.

20491 $C^{12}(n,n')3\alpha$ REACTION INDUCED BY 14.8 MeV NEUTRONS. Y.Tsuneoka.

J. Phys. Soc. Japan, Vol. 14, No. 7, 869-79 (July, 1959).

The probable mechanism of the $C^{12}(n,n')3\alpha$ reaction when induced by d—T neutrons has been deduced from a study of 403 stars in nuclear emulsions. The angular distribution of the inela tically scattered neutrons show a forward peak, and it is conclude that the reaction occured mainly through the compound nucleus an that the asymmetry at about 90° is caused by the interference of several levels. The possible decay mode of the C^{12} nucleus was also investigated, and an approximate branching ratio was obtaine assuming that the decay mode via Be^9 was negligible. Then, comparing the angular distributions of the inelastically scattered neutrons which correspond to the different decay modes, Sacks's model for the direct break-up of C^{13} was found to be in disagreement with the present experimental results.

539

20492 INVESTIGATION OF THE (n,p) REACTION ON THE Li^6 NUCLEUS.

I.Sh. Vashakidze, T.I.Kopaleishvili and G.A.Chilashvili.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 393-6 (Aug., 1960). In Russian.

The proton angular distribution is derived, by taking into account the neutron—proton correlation within the nucleus.

539.17

0493

TOTAL NEUTRON CROSS-SECTION OF MAGNESIUM.

V.M.Brajović, P.D.Mirić and R.V.Popić.

Inst. Nuclear Sci. "Boris Kidrich", Vol. 8, 145-9 (March, 1958).

Total cross-section measurements of magnesium, for neutrons e energy range 2.17 to 2.83 MeV, with good geometry indicate xistence of two resonant levels in Mg^{25} in this energy region.

539.17

0494

ANGULAR DISTRIBUTIONS OF PROTONS EMITTED IN $^{24}Mg(n,p)$ AND $^{32}S(n,p)$ REACTIONS AT 14 MeV.

olli, I.Iori, G.Marcazzan, F.Merzari, A.M.Sona and P.G.Sona.

vo Cimento, Vol. 17, No. 5, 634-43 (Sept. 1, 1960).

For each element the angular distribution is studied for a well ned group of protons, corresponding to a level group which inate a gross structure. Experimental results allow the wing conclusions: (1) the reaction mechanism for protons in the ss structures is certainly a direct surface effect; (2) it is sible to determine the *l* values of orbits from which the proton ken and where the neutron is captured. In both cases a part of spectrum can be attributed to a statistical evaporation process.

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0495

$Ni^{58}(n,p)Co^{58}$ CROSS SECTION FOR NEUTRONS OF ENERGIES BETWEEN 2.2 AND 3.6 MeV.

onzález, J.Rapaport and J.J.van Loef.

s. Rev., Vol. 120, No. 4, 1319-21 (Nov. 15, 1960).

The relative cross-section for $Ni^{58}(n,p)Co^{58}$ was measured n activation method for neutron energies of 2.2 to 3.6 MeV. The olute cross-section at 3.55 MeV neutron energy is found to be ± 30 mb by comparing the intensity of the 810 keV gamma ray o^{58} with the amount of Si^{31} formed in the $P^{31}(n,p)Si^{31}$ reaction, ch has a previously known cross-section of 96.2 ± 9.0 mb. The ss-section rises from 140 mb at 2.2 MeV to a maximum value 14 mb at 3.0 MeV. Observed cross-sections are compared with predictions of the statistical theory of nuclear reactions by using quare well potential and a diffuse edge potential. In neither case ld a satisfactory agreement with experimental data be obtained.

539.17

20496

MEASUREMENT OF THE $O^{16}(n,p)N^{16}$ CROSS SECTION AT 14.7 MeV.

J.A.DeJuren and R.W.Stooksberry.

ys. Rev., Vol. 120, No. 3, 901-5 (Nov. 1, 1960).

A recoil proton telescope was used to measure the neutron flux. ygen was incorporated in a liquid scintillator which was irradiated the flux. The absolute activity of the resulting N^{16} was measured 4π beta counting the solution with two photomultipliers in coinence. A value of 39.2 ± 1.6 mb was obtained for the cross-section.

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20497

THE SLOW NEUTRON TOTAL CROSS-SECTION OF ^{240}Pu.

N.J.Pattenden and V.S.Rainey.

actor Science, Vol. 11, No. 1, 14-18 (Nov., 1959).

The total cross-section of Pu^{240} was measured over an energy nge from 0.01 to 10 eV, using crystal spectrometers. The observans may be fitted by a single-level Breit—Wigner relation with paraeters $E_0 = 1.0575$ eV, $\Gamma_\gamma = 29.6$ meV and $\Gamma n^0 = 2.40$ meV. The sults are compared with other published data.

539.17

20498

THE THERMAL NEUTRON ACTIVATION CROSS SECTION OF ^{105}Ru.

B.L.Sharma.

ovo Cimento, Vol. 17, No. 5, 687-90 (Sept. 1, 1960).

In order to calculate the thermal neutron activation crossction of Ru^{104} was exposed to a thermal neutron flux of 1.2×10^{14} utrons cm^{-2} sec^{-1}. After the decay of the 40 day activity of Ru^{103}, e silver impurity was removed and the contributions from Co and impurities were subtracted. The γ-ray energies and the coindence results were consistent with the previously established sults for Ru^{105}-Rh^{105}. From γ-ray intensities consideration, the ermal neutron activation cross-section of Ru^{105} was calculated be (0.20 ± 0.02) barn.

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20499

EFFECTIVE RESONANCE INTEGRAL FOR URANIUM CARBIDE.

R.Vernon.

clear Sci. Engng. Vol. 6, No. 2, 163 (Aug., 1959).

Measured values of the resonance integrals for uranium metal and uranium dioxide are converted into values for uranium carbide using the recent theories of resonance integrals as given by Chernik and Vernon (Abstr. 13280 of 1960). It is shown that the values also fit a formula of the type $I = a(S/M + b)^{1/2}$.

J.F.Hill

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20500

MECHANISM OF THE $Zn^{64}(n,p)Cu^{64}$ REACTION AT INCIDENT NEUTRON ENERGIES OF 8 AND 14 MeV.

A.H.Armstrong and L.Rosen.

Nuclear Phys., Vol. 19, No. 1, 40-51 (Sept.(3), 1960).

The $Zn^{64}(n,p)Cu^{64}$ reaction was studied at incident neutron energies of 8 and 14 MeV. These experiments were part of an investigation of the adequacy of the statistical model concept of the compound nucleus to describe interactions when complex nuclei are bombarded by neutrons of energies in the region of nuclear binding energies. The spectral and spatial distributions of most of the protons indicated that the compound-nucleus hypothesis may be satisfied. The high-energy proton distributions were in sharp contrast with the predictions of the statistical model and contradict the compound-nucleus hypotheses. For 8 MeV neutron bombarding energy, there was an inordinately large probability for the emission of protons with energies considerably lower than that of the Coulomb barrier.

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20501

SEMI-PHENOMENOLOGICAL INTERPRETATION OF THE OPTICAL MODEL IN NUCLEAR REACTIONS FROM THE POINT OF VIEW OF FLUCTUATION - DISSIPATION THEOREM.

M.Namiki.

Progr. theor. Phys., Vol. 22, No. 6, 843-56 (Dec., 1959).

The behaviour of the nuclear optical model for the elastic scattering of neutrons at low energies is investigated on the theoretical basis of the fluctuation - dissipation theorem. The theory starts from a Schrödinger equation with the optical potential and the fluctuating source function. The source function, which is representative of motions of the compound nucleus, is subject to the fluctuation-dissipation theorem, in which the imaginary part of the optical potential is proportional to the correlation function of the fluctuating source function. From this it is found that the strength function characterizing nuclear reactions is represented by the Fourier transform of the correlation function of the fluctuating wave-function, and that the average rate of energy dissipation of the compound nucleus is proportional to the strength function and temperature of the compound nucleus.

539.17

20502

GAMMA-RAYS FROM NEUTRON INELASTIC SCATTERING OF MAGNESIUM, ALUMINUM, IRON AND BISMUTH.

M.Hosoe and S.Suzuki.

J. Phys. Soc. Japan, Vol. 14, No. 6, 699-707 (June, 1959).

The gamma-rays resulting from the ring scatterers of Mg, Al, Fe and Bi bombarded with 2.95 MeV neutrons were investigated. The cross-sections for the 0.845 MeV gamma-ray from Fe^{56} and for the 1.37 MeV gamma-ray from Mg^{24} were 1.10 ± 0.13 and 0.66 ± 0.10 barns respectively. The angular distributions of the gamma-rays relative to the direction of the incident neutrons were both symmetric around 90°. These cross-sections and angular distributions were compared with the statistical theory by the optical model. The results were satisfactorily interpreted using a diffuse potential well.

539.17

20503

ANGULAR DISTRIBUTION OF ELASTICALLY SCATTERED NEUTRONS.

G.N.Lovchikova.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1434-5 (1960). In Russian.

Differential cross-sections for elastic scattering of Na^{24} $(\gamma,n)D_2O$ neutrons on Pb, Bi, Fe, Sn and Al nuclei were measured in the angular interval from 30 to 150°. Values of the total elastic cross-section, transport cross-section and the mean value of the cosine of the scattering angle were derived from the measured angular distributions.

539.17

20504

DETERMINATION OF THE SCATTERING AND ABSORPTION CROSS SECTIONS OF NATURAL NEON FOR THERMAL NEUTRONS.

R.Gewin, H.Beil, R.Joly and M.Ribrag.

C.R. Acad. Sci. (Paris), Vol. 251, No. 5, 691-3 (Aug. 1, 1960). In French.

Describes measurements of the thermal absorption and scattering cross-sections for natural neon, the values obtained being $\sigma_s = 2.38 \pm 0.04$ barns and $\sigma_a \leq 50$ mb. Neutrons were obtained from the reactor EL2 and energy selection carried out by a monochromating crystal and a mechanical velocity selector. Transmission of the monoenergetic neutrons was measured through a tube filled with neon at ~ 20 atm, for neutrons between 0.004 and 0.025 eV.

R.H.Thomas

539.17

20505 THEORETICAL ANALYSIS OF ABSORPTION OF SLOW π^--MESONS IN LIGHT NUCLEI.

P.Ammiraju and S.N.Biswas.

Nuovo Cimento, Vol. 17, No. 5, 726-33 (Sept. 1, 1960).

An analysis of the π^--absorption in light nuclei is presented assuming that the absorption reaction proceeds via the two nucleon π^--capture mode, namely through the reaction $\pi^- + (N + N^0_+) \to N^0 + N^0$. Assuming the charge independence of pion—nucleon interaction and unitarity and time-reversal invariance of the S-matrix, the two nucleon π^--capture reaction cross-sections have been written in terms of the nucleon—nucleon phase-shifts. The parameters that enter into the theory are determined from the experimental observation of Ozaki et al. Using the principle of detailed balance, a check has been made of the parameters with meson production data at threshold. It is further shown that the two nucleon model provides a consistent explanation of the absorption phenomena of the π^--meson in helium and carbon.

539.17

20506 FORM FACTOR AND μ-MESON CAPTURE BY LIGHT NUCLEI WITH SPIN $\frac{1}{2}$.

Khé Tszo-Syu [Ho Tso-Hsiu].

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1620-6 (1960). In Russian.

Various processes of μ-capture by light nuclei with spin $\frac{1}{2}$ without emission of neutrons or protons are studied. Calculations show that the form factor gives significant correction to these processes.

539.17

20507 A MODEL FOR THE INTERPRETATION OF K^--MESON CAPTURES AT REST IN COMPLEX NUCLEI.

I.E.McCarthy and D.J.Prowse.

Nuclear Phys., Vol. 17, No. 1, 96-108 (June (2), 1960).

A model for the interactions of K^--mesons in complex nuclei is proposed which combines the peripheral absorption ideas of Jones (Abstr. 1202 of 1958) and to a limited extent, the idea of volume absorption proposed by Gilbert, Violet and White (Abstr. 8185 of 1957). The model is capable of explaining the observed experimental effects without demanding momentum correlations in the nucleus and without the necessity of invoking the idea of nuclear surface clusters first proposed by Wilkinson (Abstr. 15500 of 1960). The energy spectra of both the Σ^+- and Σ^--hyperons resulting from the single-nucleon reactions in emulsion nuclei in which both pion and Σ-hyperon are observed to emerge from the interaction, are well fitted assuming that these reactions mainly occur at the nuclear surface. The energy spectrum of Σ-hyperons (>60 MeV) unaccompanied by π-mesons which are assumed to result from the multi-nucleon reaction of the type $K^- + p + p \to \Sigma^+ + n$ and similar reactions, is consistent with the assumption that the nucleons involved are uncorrelated in momentum space. The relative cross-sections for the two processes are also consistent with this assumption, hence the nucleon-cluster interpretation of these events is open to doubt.

539.17 : 539.18

NON-RADIATIVE TRANSITIONS IN μ-MESIC ATOMS. See Abstr. 20567

539.17 : 621.382.232

20508 USE OF SILICON P—N JUNCTION DETECTORS IN STUDIES OF NUCLEAR REACTIONS INDUCED BY HEAVY IONS.

A.E.Larsh, G.E.Gordon and T.Sikkeland.

Rev. sci. Instrum., Vol. 31, No. 10, 1114-18 (Oct., 1960).

Experiments in which silicon p—n junctions have been used as detectors of fission fragments and elastically scattered heavy ions are described. The curve of pulse height versus energy for carbon particles is linear and passes through the origin. Points for Cf^{252} fission fragments and alpha particles fall on the curve determined by the carbon particle points. This result implies that the energy required for electron-hole pair formation is the same for the three types of particle. Also, no "ionization defect" is observed for the fission fragments. Some other possible uses for the detectors of this type are suggested.

539

20509 FISSION RECOIL AND ITS EFFECT.

G.N.Walton.

Progress in nuclear physics, Vol. 6 (London: Pergamon Press, 1957) p. 192-232.

In this review article, the fission process and the origin, me
recoil energy and energy distribution of fission fragments are
initially considered. The slowing-down of recoil fragments in the
passage through matter is discussed, with reference to the initial
ionic charge on the fragment, range-energy relationships, and
estimates and measurements of the range of fission fragments. T
effects of fission recoil on the surrounding material — atomic
displacement, effects in solids, and chemical effects — are
considered. The chemical properties and behaviour of mixed, ra
gas, and other fission products are described. The bibliography
contains 119 references.

J.B.Bir

539.

20510 KINETIC ENERGY OF THE FRAGMENTS OF U^{238} PHOTOFISSION.

B.A.Bochagov, A.P.Komar and G.E.Solyakin.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1374-80 (1960). In Russian.

A double chamber was employed to study the energy distri-
bution of the U^{238} photofission fragments. Gamma rays with
$E_{\gamma_{max}} = 70$ MeV were obtained from a synchrotron. A contour
diagram of the kinetic energy distribution of the fragments was plotte
The contour diagram for photofission of U^{238} was compared with
diagrams obtained by fission of heavy elements induced by neutron
of various energy.

539.1

20511 NUCLEAR FISSION PRODUCES TRITIUM.

E.L.Albenesius and R.S.Ondrejcin.

Nucleonics, Vol. 18, No. 9, 100 (Sept., 1960).

40-80 g samples of natural uranium irradiated for 300-1600 MWd/ton were disolved in nitric acid and the released tritium pressured by liquid scintillator counting. The measured fission to tritium ratio was $1.05 \pm 0.09 \times 10^4$.

R.D.Smith

539.

20512 RECOIL PROPERTIES OF FISSION PRODUCTS.

J.M.Alexander and M.F.Gazdik.

Phys. Rev., Vol. 120, No. 3, 874-86 (Nov. 1, 1960).

The range and relative rates of energy loss in Al and Au were
measured radiochemically for five products from thermal-neutron
induced fission of U^{235}. Range—velocity relationships for the medi
light product of fission and the median heavy product were obtaine
from these measurements and other workers' energy-loss data. T
relation of range (R) to energy (E) or velocity (V) can be fitted to
functions of the form $R = kV - \Delta$ or $R = KE^{2/3}$. It was assumed tha
these functional forms can be applied to fission products of any ma
The constants K and Δ were determined from values of the range a
kinetic energy for products of high yield. The values of these constants were extrapolated to products of low yield. Estimates of
kinetic energies, heretofore unmeasured, were made from the rang
of low-yield products. Certain radiochemical observations were
interpreted in terms of the average component of the range perpen
dicular to the original velocity. The value of this component in Au
was estimated to be about one-fifth the total range.

539.

20513 THERMAL NEUTRON $\bar{\nu}$ FOR ^{241}Pu.

A.H.Jaffey, C.T.Hibdon and R.Sjoblom.

Reactor Science, Vol. 11, No. 1, 21-30 (Nov., 1959).

The average number of neutrons per fission, $\bar{\nu}$, of Pu^{241} has b
measured at thermal energies relative to Pu^{239}, U^{235} and U^{233}. The
measurement yielded the product of $\bar{\nu}$ and the effective fission cro
section $(g\sigma_F)\bar{\nu} = 3162 \pm 72$ barn neutrons/fission. Using a measur
value $(g\sigma_F) = 1070 \pm 14$ barn, $\bar{\nu} = 2.96 \pm 0.08$ neutrons/fission.

539.

20514 COMPARISON OF THE EFFECTIVE TEMPERATURE OF NEUTRON SPECTRA EMITTED ON FISSION OF U^{235} AND Pu^{239} BY FAST AND THERMAL NEUTRONS.

G.N.Smirenkin.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1822-4 (Dec., 1959). In Russian.

The following values are reported for dT_{eff}/dE_n: 0.008 ± 0.0
(U^{235}) and 0.01 ± 0.004 (Pu^{239}). These results are lower by a facto
of 1.5-2 than would be expected on the Fermi gas model. It is
suggested that this may be partly due to the fact that the dependen

uclear temperature on the excitation energy is weaker than $\sqrt{E_{exc}}$. S.Chomet

539.17

20515 COMPARISON OF PROBABILITIES OF THE TRIPLE FISSION OF U^{233}, U^{235} AND Pu^{239}.

.Dmitriev, L.V.Drapchinskii, K.A.Petrzhak and Yu.F.Romanov.
eksper. teor. Fiz., Vol. 38, No. 3, 998-9 (March, 1960).
ussian.

Measurements were made of the ratio of the relative prob- ities of the triple fission of U^{233}, U^{235} and Pu^{239}. The results are

$$\eta(U^{233})/\eta(U^{235}) = 1.22 \pm 0.06$$

$$\eta(Pu^{239})/\eta(U^{235}) = 1.18 \pm 0.06$$

re η is the ratio of the number of triple fissions to that of ble fissions. These are shown to be in agreement with the re- s of Allen and Dewan (Abstr. 1314 of 1951). A.M.Green

539.17

20516 FISSION OF GOLD BY CARBON IONS.

G.E.Gordon, A.E.Larsh, T.Sikkeland and G.T.Seaborg.
ys. Rev., Vol. 120, No. 4, 1341-8 (Nov. 15, 1960).

Angular distribution and kinetic-energy spectra of fragments, cross-sections for fission of gold with 68 to 124 MeV C^{12} ions, re obtained by observation of the fragments in two types of ectors, gas scintillation chambers and silicon p–n junctions. om the parameters used to fit the angular distributions to the oretical curves of Halpern and Strutinski (Proceedings of the cond United Nations International Conference on the Peaceful es of Atomic Energy, Geneva, 1958, Vol. 15, p. 408) the average citation energy of the fissioning nucleus at the time of fission was tained. This quantity is approximately 25 MeV, which is nearly iependent of bombarding energy, suggesting that fission is pre- ded by the emission of several particles from the compound cleus. The fission cross-section increases from a value of 0 mb at 68 MeV to 1.28 b at 124 MeV. Over this range of mbarding energies, the total fragment kinetic-energy release rises om 142 ± 6 to 146 ± 6 MeV. At all bombarding energies, the riation of laboratory-system kinetic energy of the fragments with oratory-system angle indicates full momentum transfer by the mbarding particle to the fissioning system.

539.17

20517 RARE MODES IN THE SPONTANEOUS FISSION OF CALIFORNIUM-252. E.W.Titterton and T.A.Brinkley.

ature (London), Vol. 187, 228-9 (July 16, 1960).

Describes preliminary results obtained in the study of the pontaneous fission of Cf^{252} using the loaded emulsion technique. In study of 50 000 binary fissions, 179 cases of ternary fission and etween 8 and 12 cases of quaternary fission were observed. Other teresting groups include a mode of quaternary fission in which a ng-range α-particle and short-range light nucleus are emitted. R.H.Thomas

539.17

20518 MEASUREMENT OF THE SPONTANEOUS FISSION NEUTRON YIELD OF NATURAL URANIUM.

.W.Waltner and B.E.Leonard.
eactor Science, Vol. 11, No. 1, 1-7 (Nov., 1959).

A measurement of the spontaneous fission neutron yield of atural uranium has been made by the activation of approximately 500 l. of $KMnO_4$ solution in a sub-critical assembly containing ver 5000 lb of natural uranium. By filtering a large volume of is solution, sufficient manganese activity is removed as MnO_2 y the Szilard–Chalmers effect to provide an accuracy of 1.5% the result. However, since the total efficiency of the MnO_2 extrac- on process was not known to this high degree of accuracy, com- arison of the activation by Pu–Be sources of known strength super- mposed over the uranium was made. This provided the spontaneous ssion neutron yield of natural uranium in terms of the Pu–Be ource calibration. A value of $(1.532 \pm 0.061) \times 10^{-2}\,sec^{-1}g^{-1}$ was us obtained.

539.17 : 539.19

DIRECTED INJECTION OF DEUTERIUM AND TRITIUM IN A UCLEAR FUSION EXPERIMENT. See Abstr. 20709

NUCLEAR POWER STUDIES

539.17

20519 ZERO ENERGY REACTOR "RB".

D.Popović, S.Takač, H.Marković, N.Raišić, Z.Zdravković and Lj.Radanović.
Bull.Inst. Nuclear Sci."Boris Kidrich", Vol. 9, 5-13 (March, 1959).

In 1958 the zero energy reactor "RB" was built with the purpose of enabling critical experiments with various reactor systems to be carried out. The first core assembly built in the reactor consists of heavy water as moderator and natural uranium metal as fuel. In order to be able to obtain very accurate results when measuring the main characteristics of the assembly the reactor was built as a completely bare system.

539.17

20520 MEASUREMENT OF M^2 AND k_∞ FOR A HEAVY WATER–NATURAL URANIUM ASSEMBLY.

D.Popović, N.Raišić, H.Marković, S.Takač, Z.Zdravković and B.Lolić.
Bull.Inst. Nuclear Sci. "Boris Kidrich", Vol. 9, 15-19 (March, 1959).

The square of the migration length M and the infinite multiplication factor k_∞ of the heavy water–natural uranium bare assembly were determined by measuring the reactivity of the reactor as function of the heavy water level. Since the assembly is nonreflected the results obtained are of relatively high accuracy.

539.17

20521 MEASUREMENT OF SAFETY-ROD EFFECTIVENESS OF THE ZERO ENERGY REACTOR "RB".

N.Raišić, D.Popović, S.Takač, H.Marković, R.Martinc and Lj.Radanović.
Bull. Inst.Nuclear Sci. "Boris Kidrich", Vol. 9, 21-7 (March, 1959).

The reactivity effectiveness of the two safety rods displaced eccentrically along the diameter of a cylindrical D_2O moderated reactor was measured and compared with the theoretical calculations. The results show that the simplified calculations of the effectiveness of one rod are quite satisfactory but the theoretical evaluation of the interference effect of the two rods are not sufficiently reliable.

539.17

20522 PREDETERMINATION OF THE BEHAVIOUR OF THE TRANSIENT STATES OF THE 2000 kW REACTOR OF THE INSTITUTE OF ATOMIC PHYSICS OF THE ACADEMY OF THE ROUMANIAN PEOPLES REPUBLIC. I.Purica.

Stud. Cercetari Fiz., Vol. 10, No. 1, 19-36 (1959). In Roumanian.

The coefficients of the dynamic equations describing the reactor were determined by using transient states produced by small changes in reactivity or mean power. To check the accuracy of these coefficients, the calculated transfer function of the reactor was compared with the experimentally determined transfer function. To predict the non-linear transient states a simple equation, valid in the range $0 < \rho < \beta$, is given. D.H.Lord

539.17

20523 TWO ATOMIC PILES CONSIDERED AS PHYSICS INSTRUMENTS. P.Delattre.

Nuclear Instrum. and Methods, Vol. 6, No. 1, 83-93 (Dec., 1959). In French.

From a certain standpoint, the EL 2 and EL 3 laboratory reactors can be considered as nuclear physics instruments, in the same way as particle accelerators, for example. The essential difference between accelerators and laboratory reactors lies in the fact that the latter are not solely used for fundamental research but also for research in applied physics, technology, chemistry etc. The operation of laboratory reactors and their use for research purposes leads to a number of general problems which are listed. Four precise examples selected from among these general problems describe the methods of solution and the necessary preliminary studies.

539.17

20524 URANIUM MONOCARBIDE — FUEL OF THE FUTURE.

F.A.Rough and R.F.Dickerson.
Nucleonics, Vol. 18, No. 3, 74-7 (March, 1960).

A review of the properties, preparation, and irradiation behaviour of UC, which has high thermal conductivity, high melting point, a high uranium density and withstands higher burnup than metal. A short bibliography is included. R.D.Smith

539.17

20525 NUCLEAR POWER IN OUTER SPACE.
W.R.Corliss.

Nucleonics, Vol. 18, No. 8, 58-63 (Aug., 1960).

The power needs of space vehicles are examined and compared with the output of possible power sources, including radioisotopes, fission reactors, solar and chemical reactions. It is concluded that radioisotopes are limited to outputs of 1 kW and lifetimes of less than 10 years. For higher powers, reactors are most suitable and will provide outputs from 0.1 to 10 MW(E) at specific powers of less than 10 kg/kW. R.D.Smith

539.17

20526 ON THE USE OF DIMENSIONLESS VARIABLES IN REACTOR KINETICS.
G.B.Melese.

Nuclear Sci. Engng, Vol. 6, No. 3, 253-4 (Sept., 1959).

The asymptotic expansions for the reactivity for large and small reactor periods in the case of a step change in reactivity and for the phase shift in the case of a small sinusoidal change in reactivity can be written in terms of two dimensionless quantities, provided that the periods are referred to in terms of the average delayed neutron mean lifetime. It is seen that these dimensionless quantities are approximately the same for U^{233}, U^{235} and Pu^{239} thus enabling the reactor period against excess reactivity to be obtained from dimensionless curves when the neutron generation time is known. J.F.Hill

539.17

20527 HEAT TRANSMISSION WITH BOILING.
G.S.Emmerson.

Nuclear Engng, Vol. 5, 493-500 (Nov., 1960).

A review of the subject with special reference to nuclear reactor applications. The regimes of boiling heat transfer, including convection, nucleate and film boiling, and the various theories and equations relating to the transition regions, are described. Relations for nucleate heat transfer and burn-out correlations based on data gathered from many sources are given. 59 references. S.Weintroub

539.17

20528 ON THE THEORY OF DIFFUSION COOLING OF NEUTRONS IN A FINITE SOLID MODERATOR ASSEMBLY.
K.S.Singwi.

Reactor Science, Vol. 11, No. 1, 19-20 (Nov., 1959).

A supplementary paper to earlier work by Singwi and Kothari (see Abstr. 7374 of 1960).

539.17

20529 THERMODYNAMIC BEHAVIOUR OF NUCLEAR REACTORS.
G.Fournet.

J. Phys. Radium, Vol. 19, Suppl. No. 4, 39A-47A (April, 1958). In French.

Monomial expressions of different parameters governing the thermodynamical behaviour of a very general type of nuclear reactor have been obtained using mathematical approximations. Modifications of fundamental reactor data can be included in the theory.

539.17

20530 SAFER PACKAGES FOR SHIPPING FUEL.
W.B.Lewis and R.W.Goin.

Nucleonics, Vol. 18, No. 7, 91, 93 (July, 1960).

Calculations have been made of the thickness of a sandwich of moderator and cadmium foil necessary to give effective nuclear isolation of fissile materials. Wood and polythene moderators are considered. A fictitious fissile material with $\sigma_f = 750b$, $\nu = 2.98$ and $\sigma_c = 0$ was used in the calculations to determine safe limits for moderators used in storage or transport containers. R.D.Smith

539.17

20531 CALCULATION OF THE RATE OF ENERGY DEPOSITION IN POLYETHYLENE BY REACTOR RADIATION.
D.E.Kline and A.Jacobs.

J. appl. Phys., Vol. 30, No. 11, 1741-7 (Nov., 1959).

An attempt is made in this discussion to determine the energy deposited in a small sample in terms of impinging reactor radiations, both neutron and gamma ray. The intensities of various radiations from a nuclear reactor are often presented in terms which are difficult to manipulate or interpret for energy deposition considerations. For example, the epithermal neutron flux is usually given as the integral neutron flux above the 0.4 eV cadmium resonance. However, for some energy deposition mechanisms, such as proton recoil, the neutron energy distribut
is of utmost importance. These difficulties are partly resolved
this paper by using some empirical evidence of the characterist
of reactor radiations to convert the usual expression of intensiti
into energy deposited per gramme-hour in polyethylene. This ca
easily extended to other materials, particularly polymers. It is
also emphasized in this paper, by specific calculations for two
reactor types, that certain simplifying assumptions, which are o
made with regard to the characteristics of reactor radiation, are
invalid in energy deposition considerations.

5

20532 THEORY OF FUSION REACTIONS IN AN UNCONFIN PLASMA.
J.G.Linhart.

Nuovo Cimento, Vol. 17, No. 6, 850-63 (Sept. 16, 1960).

A criterion for a zero energy gain fusion reactor is obtaine
the reactor resembling a cylindrical H-bomb in which a plasma
either not confined or only marginally confined. A magnetically
driven cylindrical plasma shell is shown to generate a plasma
column for which the criterion could be satisfied.

ATOMS

539

20533 THOMAS–FERMI ATOMIC MODEL WITH QUANTUM AND EXCHANGE CORRECTIONS.
N.N.Kalitkin.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1534-40 (1960). In Russia

Quantum and exchange corrections to the energy and chemic
potential of the Thomas–Fermi atom are derived and numerical
calculations of thermodynamical functions for a cold atom are presented. Extrapolation of the model to the region of normal densities is considered. The calculations are compared with the experimental data.

539

20534 THOMAS–FERMI MODEL OF COMPRESSED POSIT ION.
S.Kobayashi.

J. Phys. Soc. Japan, Vol. 14, No. 8, 1121-2 (Aug., 1959).

Theoretical expressions are given which enable quantities s
as compressibility and the equation of state to be calculated.
W.J.Orville-Tho

539

20535 ANALYTICAL WAVE-FUNCTIONS AND ENERGY LEVELS OF THE STATE $1S2p^3P$ OF TWO-ELECTR ATOMS.
M.Kraev.

C.R.Acad. Bulg. Sci., Vol. 13, No. 2, 147-9 (March-April, 1960). In Russian.

The theoretical formula for the energy consists of three ter
the first of which represents the kinetic energy, the second the potential energy of electrons in the field of the nucleus and the third the energy of electron interaction. The deviation between t
theoretical and experimental energy values for He, Li^+, Be^{2+}....
increases as the atomic number rises. The theoretical formula was improved empirically, and the new theoretical values do not differ from experimental values by more than 0.01 a.m.u.
F.Lachn

539

20536 CALCULATION OF THE ENERGY EXPRESSION IN CASE OF A WAVE FUNCTION BUILT UP FROM TW ELECTRON ORBITS.
E.Kapuy.

Acta phys. Hungar., Vol. 9, No. 1-2, 237-9 (1958).

Expressions are written down for the first and second order
diagonal density matrices and for the total N-electron energy wh
the wave-function is an antisymmetrized product of N/2 two-elec
spin-orbitals, individually antisymmetric. J.Hawg

539.18 : 53

COULOMB GAUGE IN NON-RELATIVISTIC QUANTUM ELECTRODYNAMICS AND THE SHAPE OF SPECTRAL LINES.
See Abstr. 20025

539

20537 ELECTRON LEVELS OF ATOMS OF SUPER-HEAVY ELEMENTS.
V.V.Voronkov and N.N.Kolesnikov.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 189-91 (July, 1960). In Russian.

The behaviour of electron ns-levels in the field of finite size

ı with $Z > 137$ is considered near $\epsilon \sim -m$ and $\epsilon \sim +m$ on the
of the Dirac equation. The critical values $Z = Z_{cr}$ are found
ıe existence of quasi-levels for $\epsilon < -m$ and $Z_{cr} > Z_{cr}$ is
nstrated and an interpretation of them suggested.

539.18 : 539.19

538 MEASURE OF DELOCALIZATION OF AN ELECTRON IN ATOMIC AND MOLECULAR SYSTEMS.

Bochvar and N.P.Gambaryan.
. Akad. Nauk SSSR, Vol. 131, No. 3, 532–4 (March 21, 1960).
ıssian.

The entropy of a system is taken as a measure of indeterminacy
e distribution of particles. The delocalization of an electron
ono- and multi-electron systems is considered and several
le examples are given. Z.Krasucki

539.18 : 539.19

20539 INTER- AND INTRA-ATOMIC CORRELATION ENERGIES AND THEORY OF CORE-POLARIZATION.

nanoğlu.
ıem. Phys., Vol. 33, No. 4, 1212-26 (Oct., 1960).

Atomic and molecular energies depend strongly on the corre-
ın in the motions of electrons. Their complexity necessitates
treatment of a chemical system in terms of small groups of
trons and their interactions, but this must be done in a way con-
ent with the exclusion principle. To this end, a nondegenerate
y-electron system is treated here by a generalized second-order
urbation method based on the classification of all the Slater
rminants formed from a complete one-electron basis set. The
relation energy of the system is broken down into the energies
airs of electrons including exchange. Also some nonpairwise
tive terms arise which represent the effect of the other elec-
s on the energy of a correlating pair because of the Pauli
lusion principle. All energy components are written in approxi-
e but closed forms involving only the initially occupied Hartree—
k orbitals. Then each term acquires a simple physical interpre-
on and becomes adoptable for semiempirical usage. The treat-
nt is applied in detail to two particular problems: (a) the
relation energy between an outer electron in any excited state
the core electrons, e.g., in the Li atom, is represented by a
ential acting on the outer one. This potential can be regarded as
mean square fluctuation of the Hartree—Fock potential of the
e, and applies even when the outer electron penetrates into the
e. The magnitudes of some of the correlation effects are calcu-
d for Li; (b) starting from a complete one-electron basis set of
MO's, the energy of a molecule is separated into those of groups
electrons and of intra-molecular dispersion forces acting between
groups. The assumptions that are usually made in discussing
persion forces at such short distances are then removed and
erally applicable formulae are given. Some three or more
ctron-correlation effects and limitations in the use of "many
ctron group functions" for overlapping systems are also discussed.

539.18

20540 HALL'S FORMULA FOR THE RELATIVISTIC PHOTO-EFFECT. M.Gavrilă.

d. Cercetari Fiz., Vol. 9, No. 3, 317-22 (1958). In Roumanian.

For the original work see Rev. mod. Phys. Vol. 8, 358-97
ct., 1936) and Abstr. 293 of 1952, which obtained a formula for the
tal cross-section which is exact in αZ, for the limit of high
equency $h\nu/mc^2 \gg 1$. By making some approximations the express-
n for the integral $J(\alpha Z)$ was also found. However, this expression
a bad approximation for $J(\alpha Z)$, and Hall's conclusion is shown to
incorrect by evaluating the integral $J(\alpha Z)$ correctly to first
der in αZ. Expanding in powers of αZ the final expression for
$\alpha Z)$ is obtained. Apart from the second order terms O_2, the
fference between the correct result and Hall's one is $J(\alpha Z) -$
$J_H = 0.90\,\alpha Z$; this shows that J_H is 32% in error for Sn and 54%
r Pb. It is concluded that Hall's formula for the extreme relativis-
cross-section is incorrect, the errors involved being larger
an most of the terms contained in $H(\alpha Z)$. The correct expression
r σ_k to first order in αZ is given and it is shown that this result
ay also be found by an entirely different method.

539.18

20541 ENERGY LEVELS AND TRANSITION PROBABILITIES OF Fe IV. R.H.Garstang.

onthly Not. Roy. Astron. Soc., Vol. 118, No. 6, 572-84 (1958).

539.18

20542 THE SELF-CONSISTENT FIELD WITH EXCHANGE FOR THE GROUND STATE AND FIRST EXCITED STATE OF Fe^{+13}. C.Froese.

Monthly Not. Roy. Astron. Soc., Vol. 117, No. 6, 615-21 (1957).

539.18

20543 HYPERFINE STRUCTURE OF HYDROGEN, DEUTERIUM, AND TRITIUM.

L.W.Anderson, F.M.Pipkin and J.C.Baird, Jr.
Phys. Rev., Vol. 120, No. 4, 1279-89 (Nov. 15, 1960).

The optical transmission of an optically oriented rubidium vapour in spin-exchange equilibrium with atomic hydrogen, deuterium, and tritium was used to measure with high precision the hyperfine splittings of these paramagnetic atoms. The results are

$$\Delta\nu(H) = 1\,420.405\,726 \pm 0.000\,030 \text{ Mc/s},$$
$$\Delta\nu(D) = 327.384\,349 \pm 0.000\,005 \text{ Mc/s},$$

and

$$\Delta\nu(T) = 1\,516.701\,396 \pm 0.000\,030 \text{ Mc/s}.$$

These results are based on a value of the hyperfine splitting of Cs^{133} which is taken to be

$$\Delta\nu(Cs^{133}) = 9\,192.631\,840 \text{ Mc/s}.$$

These measurements were made in various buffer gases which caused a shift in the observed hyperfine splitting, and the results given represent extrapolations to zero pressure. The pressure shifts were measured for H in argon, neon, helium, and molecular hydrogen and were measured for D and T in argon and neon. The assigned limits of error represent the range of disagreement of the zero-pressure extrapolations in the different buffer gases.

539.18

20544 POLARIZATION OF A HYDROGEN ATOM IN THE GROUND STATE BY THE FIELD OF A POINT CHARGE.

V.P.Shmelov.
Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1528-33 (1960). In Russian.

The dipole moment, p, of a hydrogen atom in the ground state, induced by a positive charge e is considered as a function of the distance between the charge and the hydrogen nucleus. A proton and a hydrogen atom in this state do not form a stable system. The stability of a proton—electron—positron quasimolecule is investigated with aid of the solution thus obtained.

539.18

20545 THE QUADRUPOLE POLARIZABILITIES AND NUCLEAR SHIELDING FACTORS OF THE HELIUM SEQUENCE.

A.Dalgarno, W.D.Davison and A.L.Stewart.
Proc. Roy. Soc. A, Vol. 257, 115-21 (Aug. 23, 1960).

The quadrupole polarizabilities and nuclear shielding factors of the helium sequence are calculated to high accuracy by a combination of variational and perturbation methods. The results suggest that the simpler methods usually employed are satisfactory for computing polarizabilities but less so for computing shielding factors.

539.18

20546 THE SCREENING APPROXIMATION FOR THE HELIUM SEQUENCE. A.Dalgarno and A.L.Stewart.

Proc. Roy. Soc. A, Vol. 257, 534-40 (Sept., 27, 1960).

Perturbation methods are employed to calculate a wide range of atomic parameters relating to the ground states of the helium iso-electronic sequence, the unperturbed eigenfunctions being products of screened hydrogenic orbitals. The screening constant enters as a disposable parameter. A means of choosing it is described which yields different values for different atomic properties. It is shown quantitatively that the simple calculations involved thereby lead to results of high accuracy.

539.18

20547 $2\,^{3,1}P$ STATE OF HELIUM ATOM. G.Araki, K.Mano and M.Ohta.

Progr. theor. Phys., Vol. 22, No. 4, 469-84 (Oct., 1959).

The fairly accurate eigenfunctions of $2\,^3P$ and $2\,^1P$ states of the He atom are determined by the variation method so as to assume the simplest analytical form. The polarization of the s-orbital is taken into account, and the configuration interaction is examined. The nonrelativistic energy eigenvalues are $E_{theo}(2^3P) = -2.132\,612\,64$ and $E_{theo}(2^1P) = -2.123\,198\,66$ atomic units which include both the normal and specific mass correction.

These theoretical values are in fairly good agreement with the observed values $E_{obs}(2^3P) = (-2.132\,968\,6 \pm 7) \times 10^{-7}$ and $E_{obs}(2^1P) = (-2.123\,637\,3 \pm 7) \times 10^{-7}$ atomic units.

539.18 : 539.14

HYPERFINE STRUCTURE OF Am^{241}. See Abstr. 20329

539.18

20548 STUDY OF THE MULTIPLE COHERENT SCATTERING OF LIGHT FROM OPTICAL RESONANCE. APPLICATION TO THE 6^3P_1 LEVEL OF MERCURY. II. THEORETICAL STUDY.

J.P.Barrat.

J. Phys. Radium, Vol. 20, No. 6, 633-46 (June, 1959). In French.

For Pt I see Abstr. 10153 of 1959. The results obtained in Pt I, on the problem of multiple scattering of resonance radiation, are applied to the case of N atoms in a vapour. The equations governing the time variation of the probability amplitudes of the excited states are solved by successive approximations with respect to the coupling terms representing multiple scattering. By using geometrical approximations, the series obtained are summed up and the results are expressed as functions of a single parameter x which represents the probability for a photon emitted by one of the N atoms being absorbed by another before escaping from the resonance cell. The apparent life-time ("coherence time") of the excited level, the degree of polarization of the resonance light, the imprisonment time of the radiation are expressed as functions of x, for the different hyperfine levels of the mercury isotopes. Various approximations made in the calculation are also discussed.

539.18

20549 STUDY OF THE MULTIPLE COHERENT SCATTERING OF THE LIGHT FROM OPTICAL RESONANCE. APPLICATION TO THE MERCURY $6\,^3P_1$ TRANSITION. III. EXPERIMENTAL RESULTS.

J.P.Barrat.

J. Phys. Radium, Vol. 20, No. 7, 657-68 (Aug.-July, 1959). In French.

The results of the theory developed in Pt I and II (see preceding abstract) have been checked experimentally, in the case of multiple scattering of 2537 A optical resonance radiation ($6\,^1S_0 - 6\,^3P_1$) by mercury atoms. In particular the degree of polarization of the resonance light and the apparent lifetime ("coherence time") of the $6\,^3P_1$ level have been measured, in the case of selective excitation of an even isotope, or of one of the hyperfine levels of the odd isotopes, as functions of the number of atoms per cm^3 which effectively scatter the radiation, for fixed geometrical conditions. Effects due to variation of geometrical conditions have also been studied, as well as the width and the shape of the magnetic resonance lines in the case of double scattering. Experimental results are generally in good agreement with theoretical expectations.

539.18

20550 CALCULATION OF THE HYPERFINE STRUCTURE CONSTANTS OF THE ATOMS N^{14} AND O^{17} BY THE CONFIGURATION INTERACTION METHOD.

N.Bessis-Mazloum and H.Lefebvre-Brion.

C.R. Acad. Sci. (Paris), Vol. 251, No. 5, 648-50 (Aug. 1, 1960). In French.

Conventional Slater orbitals were used to form two configurations for N and five for O: allowing the interaction very much improved the agreement with experiment of the magnetic dipole interaction constant for N, and slightly improved it for O. The electric quadrupole moment of O^{17} was calculated to be -0.0295×10^{-24} cm^2 with only one configuration, and -0.0307×10^{-24} cm^2 with the five configurations interacting. J.Hawgood

539.16

20551 THE PARTITION FUNCTION OF NEUTRAL SODIUM.

G.Noci.

Mem. Soc. Astron. Ital., Vol. 31, No. 1, 3-9 (1960). In Italian.

The results of calculations of the partition function of neutral sodium are given. The following values of the variables θ and p_e were employed: $\theta = 0.2\ (0.2)\ 1.4$; $\log p_e = -2(1)+5$. These results are compared with those already obtained by De Jager using the methods of Claas, and the differences briefly discussed.

539.18

20552 DOUBLE RESONANCE EXPERIMENTS ON THE EXCITED STATE $4^2P_{3/2}$ OF THE ATOM Na^{23}.

H.Krüger and K.Scheffler.

J. Phys. Radium, Vol. 19, No. 11, 854-7 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). Using a double resonance technique the frequencies of the hyperfi transitions were measured. The two strongest of the three expec lines were observed at 19.6 Mc/s and 9.5 Mc/s. From intensity considerations, these are attributed to the transitions $F = 3 \rightarrow 2$ a $F = 2 \rightarrow 1$ respectively. The line width, extrapolated to zero r.f. fi is 3.6 Mc/s; this gives a calculated lifetime for the $4^2P_{3/2}$ state of 0.9×10^{-7} sec. The calculated value of the nuclear quadrupole m ment for Na^{23} is $(0.13 \pm 0.04) \times 10^{-24}$ cm^2. S.A.Ahe

539

20553 OPTICAL HYPERFINE STRUCTURE OF NEON-21.

E.Rasmussen and V.Middelboe.

K. Danske Vidensk. Selsk. mat.-fys. Medd., Vol. 32, No. 14, 15 pp (1960).

The spectroscopically resolved h.f.s. of seven Ne^{21} lines was measured, enabling the component separations of the terms $1s_2$, $1s_4$, $2p_5$, $2p_2$ and $1s_5$ to be computed. Results for the latter agree well with atomic beam resonance results (Abstr. 1713 of 1959). Both the $1s_2$ and $1s_4$ terms consist of a superposition of states with the hole in the $p_{3/2}$ and $p_{1/2}$ levels; the coefficients of these states in the wave-function are probably 0.77 and 0.64.

J.Hawgo

539.18 : 539.

ATOMIC BEAM STUDY OF THE HYPERFINE STRUCTURE O Tm^{170}. See Abstr. 20328

539.

20554 ELECTRICAL POLARIZABILITIES OF RARE GAS ATOMS BY THE HARTREE—FOCK WAVE FUNCTION

S.Kaneko.

J. Phys. Soc. Japan, Vol. 14, No. 11, 1600-11 (Nov., 1959).

The perturbation method is applied to the Hartree—Fock equa tion to calculate the dipole polarizabilities, the results being a coupled set of integro-differential equations. This theory is applie to helium and shows the accuracy of the Sternheimer approximatio The calculated value of the polarizability by this theory is about 1 smaller than the value obtained by the Sternheimer approximation which is used for neon and argon calculations. All the calculated values of the polarizabilities are compared with the values obtaine by other authors and the experimental values. The calculated valu for helium agrees quite well with the experimental one and for ne and argon the calculated values are about 1.5 times the experimen ones.

539.1

20555 ON THE CONFIGURATION fd^2 OF THORIUM II.

J.B.Ganz.

Bull. Res. Coun. Israel, Vol. 9F, No. 1, 31-42 (June, 1960).

The energy levels of this configuration are calculated by Racah's method of tensor operators and compared with the experimental data. Intermediate coupling was used without configuration interaction. The observed levels were assigned to terms wit the aid of the calculated levels.

539

20556 THE THEORY AND CALCULATIONS OF SLOW-ELECTRON COLLISIONS WITH ATOMS.

V.D.Kamenetskii.

Optika i Spektrosk., Vol. 9, No. 1, 111-13 (July, 1960). In Russia

Describes a simple method of solving the problem of slow collisions using trial functions. The new method was used to calculate scattering cross-sections of slow electrons on various atoms, excitation of hydrogen by electron collisions, and triplet scattering of neutrons and protons. A.Tybulewi

539.

20557 MAGNETIC RESONANCE OF ATOMIC LEVELS EXCITED BY ELECTRON BOMBARDMENT. I.

J.C.Pebay-Peyroula.

J. Phys. Radium, Vol. 20, No. 7, 669-79 (July, 1959). In French.

Electron bombardment produces alignment in the atomic excited states reached in a Franck and Hertz type of experiment. This allows the observation of magnetic resonance in those states. Other resonances have been observed and identified as cyclotron resonances, which are eliminated by careful design of the electro In the mercury atom resonances have been observed in the $6\,^3F_4$, $5d^9\,6s^2\,6p\,^1D_2$ levels and in a $^3P_2$ level the configuration of which h not been determined with certainty.

539.18

0558

MAGNETIC RESONANCE OF ATOMIC LEVELS EXCITED BY ELECTRON BOMBARDMENT. II.

J. Pebay-Peyroula.
J. ıys. Radium, Vol. 20, No. 8-9, 721-9 (Aug.-Sept., 1959). In F ch.

In Pt I (see preceding abstract) experiments have been described in ich magnetic resonances of levels 6 $^3F_4$, 5d^9 6s^2 6p $^1D_2$ and ^{3}F f mercury were produced. Electron bombardment was used for ex ing the levels. It is shown that measurements of the width of the ev isotope lines lead to the value of the lifetime of the level. Landé fa rs have also been determined. In the case of the odd isotopes H and Hg^{201}, the Back--Goudsmit effect of the 6 $^3F_4$ level has be studied. An approximate value of the hyperfine structure in vals of this level has been obtained. The same technique has gi n positive results on some levels of the Na atom.

539.18

0559

AN APPLICATION OF THE FA-MODIFIED TF MODEL TO THE SINGLY IONIZED NEGATIVE ION. S.Kobayashi.

ıys. Soc. Japan, Vol. 14, No. 5, 689-90 (May, 1959).

The Fermi—Amaldi method has been used to calculate the mean ation energy and the X-ray scattering factor for such ions.

J.Hawgood

539.18

20560

THE 1s—2s EXCITATION OF HYDROGEN ATOMS BY PROTON IMPACT.

.Kingston, B.L.Moiseiwitsch and B.G.Skinner.
c. Roy. Soc. A, Vol. 258, 237-44 (Oct. 18, 1960).

It is shown that the cross-sections given by the customary ond Born approximation are not reliable because of the neglect of ırge term of the fourth order in the interaction energy. The ex- ssion for the cross-section obtained by including only terms to the d order in the interaction energy is employed to calculate the ss-sections for the proton-impact excitation of the 2s state of mic hydrogen, allowance being made for distortion and polari- ion due to the 1s, 2s and $2p_{0,\pm1}$ intermediate states. When arization is ignored by neglecting all terms involving the 2p tes, excellent agreement is found with the distortion approxi- tion calculation of Bates (1959). See also following abstract.

539.18

20561

THE 1s—2s EXCITATION OF HYDROGEN ATOMS BY ELECTRON IMPACT.

E.Kingston, B.L.Moiseiwitsch and B.G.Skinner.
oc. Roy. Soc. A, Vol. 258, 245-50 (Oct. 18, 1960).

The expression for the cross-section obtained from the second rn approximation by including only terms to the third order in interaction energy is employed to calculate cross-sections for electron-impact excitation of the 2s level of atomic hydrogen, owance being made for distortion and polarization due to the 1s, and $2p_{0,\pm1}$ intermediate states. These cross-sections are com- red with the available experimental data. See also preceding stract.

539.18

20562

EXCITATION PROCESSES IN HELIUM.

A.H.Gabriel and D.W.O.Heddle.
oc. Roy. Soc. A, Vol. 258, 124-45 (Oct. 4, 1960).

An experimental study of the radiation emitted by helium der controlled electron impact is described. The observations e analysed, together with those of previous workers, to yield lues for the excitation functions of S, P and D states. The echanism of excitation transfer between excited states is alysed in terms of radiative and collisional processes, cascade ocesses being found to be more important than has hitherto been sumed. The total inelastic (less ionization) cross-section at 8 eV is found to be 2.9×10^{-17} cm^2.

539.18

20563

THE EXCITATION OF THE 2^{3}P STATE OF HELIUM BY ELECTRON IMPACT.

[S.W.] Massey and B.L.Moiseiwitsch.
oc. Roy. Soc. A, Vol. 258, 147-58 (Oct. 18, 1960).

Cross-sections for excitation of the 2^{3}P state of helium from e ground state were calculated by the distorted-wave method. The larization of radiation emitted as a result of the excitation was so calculated. Comparison was made with the corresponding sults given by the Born—Oppenheimer approximation. Although ere were considerable differences at electron energies below 100 eV, these were much less marked than for the excitation of the 2^{3}S state. The distorted-wave method gave cross-sections in closer agreement with observation but substantial discrepancies still remained. It was difficult, however, to estimate their magnitude with any certainty because there were inconsistencies in the observed data.

539.18

20564

THE SPECTROSCOPY OF MESONIC ATOMS.

M.B.Stearns.

Progress in nuclear physics, Vol. 6 (London: Pergamon Press, 1957) p. 108-37.

This review article begins by a consideration of the theory of various effects in μ-mesonic and π-mesonic atoms. This is followed by a survey of the experimental results on mesonic atoms. The main topics discussed are the Auger effect and the cascade process, meson capture in chemical compounds, the finite nuclear size from μ-mesonic X-rays, spin of the μ-meson, masses of the π^- and μ^- mesons, nuclear absorption from π-mesonic atoms, and energies of π-mesonic X-rays. Possible future experiments on mesonic atoms are briefly discussed.

J.B.Birks

539.18 : 539.12

20565

DECAY OF BOUND MUONS.

V.Gilinsky and J.Mathews.

Phys. Rev., Vol. 120, No. 4, 1450-7 (Nov. 15, 1960).

The decay rate of bound muons from the K shell is calculated for elements up to lead. The muon is represented by a relativistic wave-function for a point nucleus with parameters adjusted for finite-nuclear-size effects. The outcoming electron is represented by a Sommerfeld—Maue wave-function. The decay rate is found to be a monotonically decreasing function of the atomic number. An estimate of the error is obtained by comparing with an exact calculation for the lowest electron angular state. The spectrum and angular distribution of the electrons are also presented.

539.18

20566

TRANSITIONS BETWEEN HYPERFINE STRUCTURE LEVELS IN μ-MESIC ATOMS. A.E.Ignatenko.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1515-17 (1960). In Russian.

The possibility of an experimental verification of the existence of transitions between hyperfine structure levels in mesic atoms is considered. It is shown that, in the case of mesic atoms possessing nuclear spins $J > \frac{1}{2}$, measurement of the precession frequency of the mesic atoms should be a convenient method.

539.18 : 539.17

20567

INTENSITY OF NON-RADIATIVE TRANSITIONS IN μ-MESIC ATOMS. M.Ya.Balats, L.N.Kondrat'ev,

L.G.Landsberg, P.I.Lebedev, B.V.Obukhov and B.Pontekorvo [Pontecorvo].
Zh. eksper. teor. Fiz., Vol. 39, No. 4(10), 1168-70 (Oct., 1960). In Russian.

X-ray spectra from the 2P—1S transition in Pb, Bi, Th, U^{235}, and U^{238} were measured. A gas-filled Cherenkov counter removed electrons and pions from the incident muon beam, considerably reducing the background. Measurements on Mo and Cd allowed a correction for the 3D—2P transition. It was found that in Th, U^{235}, and U^{238} respectively, 15 ± 7%, 29 ± 5%, 23 ± 4% of the transitions are non-radiative. A discussion of possible mechanisms indicates that nuclear excitation followed by gamma emission is responsible for the effect.

D.W.L.Sprung

539.18

20568

MASSES OF ATOMS OF A > 40.

H.E.Duckworth.

Progress in nuclear physics, Vol. 6 (London: Pergamon Press, 1957) p. 138-61.

The sources of atomic mass information — mass spectrometry, nuclear reactions, beta- and alpha-disintegration energies, and microwave spectroscopy — are reviewed. A table of precise doublet values for nuclides of Z ≥ 19, supplementary to the July 1954 list (Abstract 2102 of 1955) is given. The need for standards of atomic mass among the heavier elements is discussed and 12 secondary standards are suggested. The possibility of a future unification of the physical and chemical scales of atomic mass, by the anisotopic F^{19} replacing O^{16} as a primary standard, is considered. Atomic masses for A ≥ 40 are tabulated, to 6 decimal places, with probable errors.

J.B.Birks

539.18

20569 MASSES OF ATOMS OF A < 40.
J.Mattauch and F.Everling.
Progress in nuclear physics, Vol. 6 (London: Pergamon Press, 1957) p. 233-66.

The three kinds of experimentally determined Q-values are considered, Q_r the energy liberated in nuclear reactions, Q_β the total β-ray energy, and Q_m the mass-spectrographic doublet energy. The least-squares computation of masses from nuclear reaction data is discussed, and improved Q_r values for several nuclear reactions are tabulated. The least-squares calculation yields a table of 70 primary mass excesses and their errors. In addition 21 secondary mass excesses and errors are calculated from other Q_r data. The corresponding binding energies are calculated, and presented graphically, and the results are discussed in terms of the shell model. A detailed comparison is made with the mass spectroscopic Q_m data, which in general yield masses larger than those computed from Q_r, by an amount exceeding the errors given. The possible sources of this discrepancy are discussed, and it is considered that it is probably due to small cumulative errors in the Q_r-values. J.B.Birks

539.18 : 539.14

20570 RELATIVE NUCLIDIC MASSES.
F.Everling, L.A.König, J.H.E.Mattauch and A.H.Wapstra.
Nuclear Phys., Vol. 18, No. 4, 529-69 (Sept. (2), 1960).

The accompanying mass table gives a complete and consistent list of nuclidic masses (the term relative nuclidic mass refers to the mass of a neutral atom of a nuclide relative to some standard atom) and also a few derived quantities.

539.18

20571 ISOTOPE SEPARATION BY MULTISTAGE METHODS.
T.F.Johns.
Progress in nuclear physics, Vol. 6 (London: Pergamon Press, 1957) p. 1-25.

The most important multistage methods of isotope separation are electrolysis, fractional distillation, chemical exchange methods and gaseous and thermal diffusion. In this article a general account is given of these methods, and their relative advantages and limitations are indicated. The 53 references given are intended to be representative rather than comprehensive. J.B Birks

539.18

20572 ELECTROMAGNETIC ENRICHMENT OF STABLE ISOTOPES. M.L.Smith.
Progress in nuclear physics, Vol. 6 (London: Pergamon Press, 1957) p. 162-91.

This article gives a full account of the advantages and limitations of the electromagnetic process of isotope separation. After an historical account of the development of the large 180° separator, a general description is given of the present production machine at A.E.R.E., Harwell. The separation process is considered in detail, and the chemical problems involved in processing isotopic concentrates are discussed. The applications of enriched stable isotopes are briefly surveyed, and the isotopes available from Harwell and Oak Ridge are listed. The usefulness of small laboratory electromagnetic separators is considered, and a complete list of medium and large separators is given. The article concludes with a discussion of the future of the technique. The bibliography, while not exhaustive, includes references to all the major sources, which are well documented, but the patent literature is omitted.
J.B.Birks

539.18

20573 NOTE ON THE FEASIBILITY OF THE BORON FLUORIDE MONOHYDRATE PROCESS OF BORON ISOTOPE SEPARATION. S.V.Ribnikar and Ž.V.Knežević.
Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 9, 111-13 (March, 1959).

539.18

20574 A SEMI-STIGMATIC ELECTROSTATIC ANALYSER FOR ISOTOPE SEPARATION.
C.Cassignol, G. Ranc and R.Salvaudon.
J. Phys. Radium, Vol. 19, Suppl. No. 12, 150A-153A (Dec., 1958).
In French.

The good results obtained by the addition of an electrostatic stage to the Saclay electromagnetic separator permitted the continuation of the work and the correction of residual weaknesses. The major improvement lies in the electrostatic field pattern. A double convergence was achieved, called half-stigmatism. The images are of smaller area and the transmission factor of the apparatus is greater than for the cylindrical field structure. Nevertheless, the isotopic purity of the products collected remains the same.

539.18 : 53

20575 EXTRACTION OF TRITIUM PRESENT IN HELIUM-3.
M.J.W.Elliott.
Rev. sci. Instrum., Vol. 31, No. 11, 1218-22 (Nov., 1960).

The concentration of tritium present in 10 litres of He^3 was reduced to the order of 10^{-11} by absorption of the tritium in pyrophoric uranium. This purity was required in order that the resolution of a gridded ionization chamber neutron spectrometer containing the He^3 should not be adversely affected by the tritium. Details of the purification system and method are given. The assay of the tritium by introduction of samples of the He^3 into Geiger counters is discussed.

539.18 : 539.2

ISOTOPE SEPARATION USING FINE-PORED SILVER MEMBRANES. See Abstr. 18385

539.18 : 533.

INVERSION OF THE UNMIXING PROCESS IN SEPARATION JETS. See Abstr. 19183

539.18 : 537.5

THE STABILITY OF ION BEAMS IN ELECTROMAGNETIC ISOTOPE SEPARATORS. See Abstr. 19782

539.

20576 ELASTIC AND INELASTIC SCATTERING OF ELECTRONS FROM THE S STATES OF ATOMIC HYDROGEN. K.Smith.
Phys. Rev., Vol. 120, No. 3, 845-7 (Nov. 1, 1960).

Total elastic and inelastic cross-sections for the scattering o electrons (including exchange) from the 1s, 2s, and 3s states of atomic hydrogen are calculated in three approximations using the method of partial waves. The S-, P-, and D-wave contributions to the elastic, Q_{1s-1s}, and inelastic Q_{1s-2s}, cross-sections are prese

539.

20577 COLLISIONS INVOLVING THE CROSSING OF POTENTIAL ENERGY CURVES. D.R.Bates.
Proc. Roy. Soc. A, Vol. 257, 22-31 (Aug. 22, 1960).

The Landau—Zener atomic-collision formula for the transitio probability at a crossing of potential energy curves is discussed. It is pointed out that the model used in the derivation has defects which make the range of validity of the formula much more restricted than is commonly supposed.

539.

20578 NOTE ON THE LOW ENERGY ELECTRON—HYDROGEN SCATTERING.
T.Ohmura, Y.Hara and T.Yamanouchi.
Progr. theor. Phys., Vol. 22, No. 1, 152-4 (July, 1959).

The range of validity of an effective range approximation give in an earlier paper (Abstr. 11503 of 1960) is examined by comparis with a variational calculation (Abstr. 4368 of 1958). P.K.Ka

539.

20579 CHARGE TRANSFER BETWEEN ATOMIC HYDROGEN AND N^+ AND O^+.
R.F.Stebbings, W.L.Fite and D.G.Hummer.
J. chem. Phys., Vol. 33, No. 4, 1226-30 (Oct., 1960).

The cross-sections for charge transfer in collisions between atomic hydrogen and singly charged atomic ions of nitrogen and oxygen were measured within the energy range from 400 to 10 000 using modulated-beam techniques. The results are compared with recent calculations.

539.18 : 539.

LONG-RANGE INTERACTION OF TWO 1s-HYDROGEN ATOM See Abstr. 20687

538.

20580 INTERACTION BETWEEN ARGON ATOMS.
E.A.Guggenheim and M.L.McGlashan.
Proc. Roy. Soc. A, Vol. 255, 456-76 (May 10, 1960).

The interaction energy between argon atoms is correlated wi the following experimental properties of argon: the temperature dependence of the entropy, the energy, and the density of the crys the pressure dependence of the density of the crystal; the temperature dependence of the second virial coefficient of the gas he viscosity at high temperatures of the gas. The interaction gy which best accords with all these properties is strikingly rent from the commonly advocated difference between an rse twelfth power and an inverse sixth power of the distance.

539.18

0581

STUDIES ON THE RETARDED INTERACTION BETWEEN NEUTRAL ATOMS. I. THREE-BODY DON—VAN DER WAALS INTERACTION OF NEUTRAL ATOMS.

Aub and S.Zienau.

. Roy. Soc. A, Vol. 257, 464-76 (Sept. 27, 1960).

An expression for the non-additive, three-body interaction gy of three neutral atoms is deduced, by the methods of quantum rodynamics. Non-relativistic reduction and dipole approxima- result is an expression which for interatomic separations R ll compared to the wavelengths of typical atomic transitions re- s to the triple-dipole energy varying as R^{-9} (Axilrod and Teller) eas at distances large compared with these wavelengths, the e-body interaction energy becomes proportional to R^{-10}, owing e influence of retardation.

539.18

20582

INHOMOGENEOUS VECTOR COUPLING IN ATOMIC SPECTRA. A.M.Gutman and I.B.Levinson.

ron. Zh., Vol. 37, No. 1, 86-7 (1960). In Russian. English nslation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, 83-4 y-Aug., 1960).

Possible forms of vector coupling in configurations with a ongly excited electron are considered. It is pointed out that it necessary to take into account inhomogeneous coupling in the ssification of states.

539.18

20583

CRITERIA OF APPLICABILITY OF THE THEORETICAL INTENSITIES TO THE SPECTRA OF COMPLEX OMS IN THE CASE OF LS-COUPLING.

.Gruzdev and G.P.Startsev.

ika i Spektrosk., Vol. 8, No. 6, 879-80 (June, 1960). In Russian.

Suggests and illustrates the following two criteria of applica- ty of the theoretical atomic spectral intensities, calculated on assumption of normal LS-coupling; (1) the differences between measured and theoretical values of Lande's g-factor should not eed 0.030-0.050, and (2) departures from the "interval rule" uld not, in general, be greater than 20%. A.Tybulewicz

539.18

20584

QUADRUPOLE AND FORBIDDEN LINES IN THE L-EMISSION SPECTRUM OF BISMUTH 83.

G.Gokhale, A.N.Nigam and K.S.Srivastava.

sci. industr. Res., Vol. 18 B, No. 11, 449-54 (Nov., 1959).

The design and construction of a 40 cm. curved crystal trans- ssion spectrograph are described; the spectrograph was used study the quadrupole and forbidden lines in the L-emission ectrum of Bi^{83}. Three new forbidden lines at 998.4, 1032.5 and .7 X.U. corresponding to the transitions L_IM_I, $L_{II}M_{II}$ and $L_{II}N_{II}$ spectively were reported for the first time. The presence of the adrupole line t (1272.23 X.U.) corresponding to the transition M_{II} was conclusively established. The measurements on the eviously known quadrupole and forbidden lines were compared th those of the earlier workers.

539.18

20585

A NOTE ON THE SPECTRUM OF Br IV.

Y.Bhupala Rao.

dian J. Phys., Vol. 33, No. 12, 546-7 (Dec., 1959).

Nine more lines are classified and given with the corresponding nergy levels. G.H.C.Freeman

539.18

20586

MULTIPLET STRUCTURE AND HYPERFINE STRUCTURE OF THE SPECTRUM OF MERCURY. K.Murakawa.

. Phys. Soc. Japan, Vol. 14, No. 11, 1624-33 (Nov., 1959).

Analysis of the spectrum of Hg I resulted in locating the level $d^96s^26p\ ^1F_3$ in the range 4392-4139 cm^{-1} measured from the ioniza- ion limit or 79792-80045 cm^{-1} measured from the normal state. he compositions of some levels of the configurations $5d^96s^26p$ and $d^{10}6s6p$ were calculated. The h.f.s. of some lines of the mercury pectrum was measured using enriched isotope as well as natural ercury. The quadrupole moment of Hg^{201} that was deduced from he h.f.s. of $5d^26s^26p\ 1D_2$ is 0.43 barn, the shielding correction being eglected. If the correction is introduced, this becomes somewhat smaller, but is still reasonable in agreement with the value 0.4_2 barn that was published previously by the author. The agreement seems to indicate that the wavefunctions for the configuration $5d^96s^26p$ given in the present work are accurate enough for calculating the quadrupole moment. It is concluded that $Q(Hg^{201}) = 0.4_2$ barn, the shielding correction being included.

539.18

20587

FREE-FREE CONTINUUM OF OXYGEN.

R.G.Breene, Jr and M.C.Nardone.

J. Opt. Soc. Amer., Vol. 50, No. 11, 1111-14 (Nov., 1960).

Oxygen is treated in an example calculation of the free—free absorption cross-section. Wave-functions for the free electron in the field of an oxygen atom under the assumption of no electron exchange or core polarization are calculated on the IBM 704. These wave-functions are applied to the calculation of the free-free absorption corresponding to a particular continuum frequency and initial state energy. In this calculation the dipole acceleration form of the matrix element is computed. The matrix element calculation is carried out in the LGP-30. These partial cross-sections are smeared over a Maxwell—Boltzmann distribution of initial electronic energies in order to obtain the free—free cross-section. The results are in approximate agreement with the familiar classical Kramers result for an effective Z of 0.35, although the frequency dependence is noticeably different. The calculation was carried out for the temperatures 8000°, 6000°, and 4000°K and it was found that there was no temperature dependence in the cross-section, at least in this range. The calculation is also carried out under the assumption of a mean electron velocity at 8000°K. The magnitude does not differ much although the wavelength dependence is somewhat less.

539.18

20588

STRUCTURE AND ZEEMAN EFFECT IN THE SPECTRA OF THE OSMIUM ATOM Os I AND Os II. I-III.

T.A.M.Van Kleef.

Proc. K. Ned. Akad. Wetensch. B, Vol. 63, No. 4, 501-16, 517-32, 533-48 (1960).

An investigation of published and unpublished data on the Os I spectrum resulted in the quantum interpretation of known energy levels and the detection of a number of new ones. In all, 154 of the 262 levels now known are labelled, among which are practically all the ground levels. These belong to the even electron configurations $5d^66s^2$ and $5d^76s$, whereas none could be attributed to $5d^8$. In the odd system, most levels could be assigned to multiplets of the configurations $5d^66s6p$, $5d^56s^26p$ and $5d^76p$. Many of the high even states are associated with the configurations $5d^66s7s$, $5d^56s^27s$ and $5d^66s6d$. Due to a former misinterpretation, the existing value for the ionization potential is too high. An improved value of (8.5 ± 0.1)V is derived. Critical examination of the levels accepted by previous authors proved that 14 were fortuitous; several others not satisfying the present author's requirements have been maintained tentatively. On the other hand, 19 new levels could be established, namely 3 low even, 10 odd and 6 high even ones, so that the total numbers belonging to those three groups are now 45, 178 and 39, respectively. For practically all levels in the two groups and for about half of the high even states the g-factors are known. A complete table of all the relative energy levels with their properties is given. These account for 2968 observed lines classified as 3293 transitions, that is about 40% of the total number of observed Os I lines and a much bigger proportion of the total intensity. The classified lines and their intensities and observed Zeeman splittings are listed. Some improvement was also obtained in the analysis of the Os II spectrum. The lowest term of the $5d^56s^2$ configuration ($^6S_{5/2}$) could be identified. The odd system was extended with 4 new states, one of which could be interpreted as $5d^56s(^7S)6p\ ^8P_{9/2}$. Two existing levels are recognized as the corresponding $^8P_{7/2}$ and $^8P_{5/2}$. This octet is the lowest odd multiplet. The number of classified Os II-lines is 162, being about 15% of the total number of observed lines. The energy levels and classified lines are tabulated.

539.18

20589

HYPERFINE STRUCTURE AND NUCLEAR MAGNETIC MOMENT OF PLUTONIUM 239.

R.J Champeau and S.Gerstenkorn.

C.R. Acad. Sci. (Paris), Vol. 251, No. 3, 352-4 (July 18, 1960). In French.

The measurement of the hyperfine structures of the plutonium II lines λ4536.1 and 4657.4 A has been made by means of a Fabry—Perot photoelectric spectrometer and a hollow cathode source.

Using the Goudsmit—Fermi—Segré formula and making some assumptions about the spectral classification of Pu II, the authors obtain $\mu = +0.27 \pm 0.06$ nuclear magnetons for the nuclear moment.
K.A.Thomas

539.18

20590 OSCILLATOR STRENGTHS OF NEUTRAL ATOMS OF THE IRON-GROUP. C.W.Allen.
Monthly Not. Roy. Astron. Soc., Vol. 121, No. 3, 299-32 (1960).

Measurements from various sources of the relative oscillator strengths of multiplets in Sc, Ti, V, Cr, Mn, Fe, Co, Ni have all been reduced to a consistent absolute scale. This makes it possible to compare experimental accuracy, make certain corrections, and tabulate mean measurements. The measurements are then compared with calculations based mainly on an elaboration of the f-sum rule. The character of the results differs for three sets of multiplets as follows: (a) for the transition types A, E, F, G, H, which involve non-equivalent electrons only, the log (observed/calculated) intensity is almost independent of excitation potential or wave-length. The scatter is probably due to unsuitability of the designations or to the interaction of terms. When absolute f-value measurements (for Cr, Mn, Fe, Co, Ni only) are used to convert these multiplets to a measured absolute scale, all atoms are within a factor 3 of the calculated scale. The high (obs/calc.) value in Mn is discussed. There is only a small systematic difference between observation and calculation. (b) for the transition types B, C, which involve equivalent electrons, the scatter of the results is much larger. Multiplets with an upper excitation potential less than 4 eV have f-values below the calculations, while above 4 eV values agree with the calculated absolute scale. (c) measured values of multiplets violating LS-coupling vary erratically between zero and an empirically calculated value. Recommended corrections for putting the mean values onto the best absolute scale are given.

539.18

20591 THE POSSIBILITY OF DETECTION OF ALLOWED LINES OF ATOMIC HYDROGEN IN THE RADIOFREQUENCY SPECTRUM. N.S.Kardashev.
Astron. Zh., Vol. 36, No. 5, 838-44 (1959). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 3, No. 5, 813-20 (March-April, 1960).

The emission of hydrogen lines due to transitions between levels with large quantum numbers n is considered. It is shown that transitions of the type $n \rightarrow n-1$ have the highest transition probability. The oscillator strength of such transitions is $f = n/6$, which is several orders of magnitude higher than the oscillator strength for transitions between components of fine and superfine structure. An estimate of the intensity shows that the lines can be observed in the far infrared up to decimetre wavelengths.

539.18 : 523.16

20592 THE CONTINUOUS ABSORPTION COEFFICIENT OF IONIZED HYDROGEN AT RADIO WAVE LENGTHS. M.Rudkjøbing.
Ann. Astrophys., Vol. 22, No. 2, 118-22 (1959).

A general expression for the hydrogen free—free absorption coefficient, derived wave-mechanically, is shown to agree asymptotically with a formula based on Kramers's classical results in the limit of long wavelengths and for physical conditions such as those in the solar corona or in dense nebulae.

539.18 : 533.7

OPTICO-ACOUSTIC EFFECT IN MERCURY VAPOUR. See Abstr. 19214

539.18

20593 THE INTERPRETATION OF THE STRUCTURE OF THE TUNGSTEN BREMSSTRAHL-ISOCHROMAT AT THE SHORT-WAVE LIMIT. J.Kessler and K.Ulmer.
Z. Phys., Vol. 159, No. 4, 443-55 (1960). In German.

The matrix elements for transitions from the continuum to the 5d and 6s levels of the isolated tungsten atom have been calculated. On this basis it is shown that both types of transition have roughly equal probabilities and so Nijboer's selection rule forbidding transitions to d-states is questionable.
W.J.Orville-Thomas

539.18 : 539.2

20594 SOFT X-RAY EMISSION FROM POTASSIUM METAL IN THE 40-1000 A RANGE. R.S.Crisp.
Phil. Mag. (Eighth Ser.), Vol. 5, 1161-9 (Nov., 1960).

The emission in the 40-1000 A range, excited in a potassium target by electron bombardment, was examined using the grazing incidence photon counting spectrometer described previously. A total of seven lines and bands were observed of which two were identified as the L and M valence spectra, three were identified diagram lines, and two broad lines remained unidentified. An en level scheme for solid potassium in emission was constructed. note regarding the energy of the L_1 level in sodium, magnesium a aluminium is appended.

539.18 : 53

Si Kβ-BANDS. See Abstr. 20639

539

20595 CONTRIBUTION TO THE STUDY OF TITANIUM. I. EMISSION AND K ABSORPTION SPECTRA OF X-RA OF TITANIUM. C.Kurylenko.
Cahiers de Phys., Vol. 11, 261-7 (Aug.-Sept., 1957). In French.

Previous data on the $K\alpha_3$, $K\alpha_4$ and $K\beta''$ lines of X-rays from elements of atomic number 19 to 28 are discussed. Anomalies in the results for titanium are interpreted in terms of the electronic energy levels.
G.I.W.Llewel

539

20596 TECHNIQUE FOR OBTAINING ABSORPTION AND EMISSION SPECTRA OF X-RAYS. C.Kurylenko.
Cahiers de Phys., Vol. 14, 68-80 (Feb., 1960). In French.

See Abstr. 9331 of 1960. Work on the influence of the physica and chemical state on the position of absorption edges of atoms is reviewed.
A.R.Stok

539.18 : 53

DIFFERENT FORMS OF MULTIPOLE RADIATION IN THE X-RAY SPECTRUM. See Abstr. 19887

MOLECULES

539

20597 DYNAMICS OF THE QUASI-LINEAR MOLECULE. W.R.Thorson and I.Nakagawa.
J. chem. Phys., Vol. 33, No. 4, 994-1004 (Oct., 1960).

Calculations of energy levels, eigenfunctions, dipole transitic moments, and other significant properties have been made for a phenomenological model of a two-dimensional harmonic oscillato with a superposed barrier at the minimum of the harmonic potent A high-speed electronic digital computer was employed. The me of calculation does not involve perturbation theory and converges rapidly for all barrier heights. The problem concerns the behavi of the degenerate bending vibration of a linear triatomic molecule example, when a potential barrier is introduced at the linear configuration. In the limit of a high barrier, the motion is that of a "bent" molecule with rotational motion superposed on the bending vibration about the minimum of potential energy. Results for moderate to low barriers, and those for anharmonic vibration in well with no barrier, show that the rigid classification of molecul as "linear" or "bent" is not possible in some cases and that the intermediate case of the "quasi-linear" molecule must be consider The dynamical behaviour of such anharmonic motion and its inter tion with other vibrations have been investigated, and the primary identifying characteristics of the quasi-linear molecule delineate The analytical method of solution used has also been applied succ fully to the one-dimensional barrier problem.

539

20598 THE PROPAGATION OF SOUND WAVES IN PARTIA DISSOCIATED N_2O_4 AND N_2O_3.
H.J.Bauer, H.O.Kneser and E.Sittig.
Acustica, Vol. 9, No. 3, 181-3 (1959). In German.

The old problem of studying the rate of dissociation of N_2O_4 been tackled with ultrasonic pulses of 10^6 c/s, at pressures from 0.1 to 20 atm, and temperatures of 20 and 50° C. Good agreemen between experiment and calculation was obtained for pure N_2O_4, whereas the addition of an inert gas, such as Ar, raised the maxi mum of the absorption index, possibly owing to a dissociation rel ation. In the case of N_2O_3 an addition of NO also raised the maximum of the absorption index. It is likely that $NO-NO_2$ collisions have a higher activation probability than $N_2-N_2O_4$ or $Ar-N_2O_4$ collisions.
R.Schnurm

539.19

0599 DISSOCIATION ENERGIES OF DIATOMIC MOLECULES.

G.R.Somayajulu.

em. Phys., Vol. 33, No. 5, 1541-53 (Nov., 1960).

Force constant, dissociation energy, and equilibrium inter-ear distance in a sequence of similar diatomic molecules are l to be related by the expression $k_e r_e/D_0$ = const. The appli-ity of this relationship is shown for eighteen sequences of lar molecules. With the help of this relationship, the disso-on energies of several important diatomic molecules were rmined. Evidence is adduced in favour of the value 170 kcal the heat of sublimation of graphite.

539.19 : 537.56

THE DISSOCIATION OF FAST H_2^+ IONS BY HYDROGEN.

Abstr. 19610

539.19

0600 THE FORCE CONSTANTS AND INTERACTION CONSTANTS OF PYRAMIDAL HYDRIDES.

Rybakova, D.S.Koval'chuk and V.P.Morozov.

a i Spektrosk., Vol. 9, No. 1, 34-9 (July, 1960). In Russian.

Recent results (Abstr. 13743 of 1959) were used to calculate orce constants and interaction constants of NH_3, PH_3, AsH_3,

A.Tybulewicz

539.19

0601 r-CENTROIDS AND THEIR PROPERTIES FOR ($B^1\Sigma \rightarrow X^1\Sigma$) SYSTEM OF BeO.

Tawde and N.S.Murthy.

. Soc. Roy. Sci. Liege, Vol. 29, No. 11-12, 325-9 (Nov.-Dec.,).

The r-centroids for the bands of the BeO (B → X) system were puted by (1) the quadratic equation procedure and (2) numerical gration using the Morse wave-function. The results from these treatments are compared. There is a smooth relationship be-n the r-centroid and wavelength.

539.19

0602 TORSIONAL VIBRATIONS OF THE TWO METHYL GROUPS IN ACETONE.

K.D.Möller.

. Acad. Sci. (Paris), Vol. 251, No. 5, 686-8 (Aug. 1, 1960). In nch.

By taking the mutual interaction of the methyl groups into ount, a theoretical estimate of the infra-red active methyl ional vibration in acetone has been obtained which is within m^{-1} of that found experimentally. W.J.Orville-Thomas

539.19

20603 ENERGY LEVELS OF A SLIGHTLY ASYMMETRIC TOP.

J.E.Beam and H.L.Davis.

hem. Phys., Vol. 33, No. 4, 1255-6 (Oct., 1960).

Gives corrections to a table in a paper by Norris and Laurie str. 13431 of 1960).

539.19

20604 ERRATUM: ENERGY LEVELS OF A SLIGHTLY ASYMMETRIC TOP.

J.A.Norris and V.W.Laurie.

hem. Phys., Vol. 33, No. 4, 1256 (Oct., 1960).

See preceding abstract.

539.19

20605 ON THE SYMMETRY OF NORMAL MODES.

R.A.Satten.

molecular Spectrosc., Vol. 5, No. 3, 264-5 (Sept., 1960).

Diagrammatic representations of normal modes can be obtained drawing arrows to indicate atomic displacements so that the ultant mode picture remains invariant under all operations of the ilibrium symmetry group. This procedure has now been eralized so that certain two-fold degenerate modes are included well as the non-degenerate fundamental vibrations.

W.J.Orville-Thomas

539.19 : 534.8

ULTRASONIC STUDIES OF INTERNAL MOLECULAR TATION.

See Abstr. 19325

539.19

20606 ROTATIONAL EFFECT ON THE THERMODYNAMIC PROPERTIES OF ISOTOPES.

A.Babloyantz.

lecular Phys., Vol. 2, No. 1, 39-48 (Jan., 1959).

It is shown that the differences in the thermodynamic properties HT and D_2 is due to the fact that, for the same total mass, the distribution of mass between the two atoms is not the same. This fact introduces for the heteronuclear molecules a correlation between translational and rotational degrees of freedom. This is a pure quantal effect. A quantum-mechanical perturbation calculation shows that the energy of the ground state is higher for assemblies of heteronuclear molecules than for assemblies of homonuclear ones. On account of this the equation of state of heteronuclear hydrogen molecules is different from that of homonuclear hydrogen molecules. This permits an understanding, for example, of the higher vapour pressure of HT compared to D_2 and the anomalous behaviour of HD.

539.19

20607 A SPECTROSCOPIC INVESTIGATION OF THE PROCESSES OF TRANSFORMATION OF THE VIBRATIONAL ENERGY OF COMPLEX MOLECULES DURING COLLISIONS. I. DETERMINATION OF THE AMOUNT OF ENERGY TRANSFERRED AND OF THE COLLISION EFFICIENCY.

B.S.Neporent and S.O.Mirumyants.

Optika i Spektrosk., Vol. 8, No. 5, 635-42 (May, 1960). In Russian.

Reviews earlier work of Neporent (1939, 1950) and others on stabilization of excited complex molecules, i.e. on decrease of the probability of radiationless transitions due to transfer of the excess vibrational energy on collision with foreign molecules. It is shown that in such collisions it is necessary to allow for the energy exchange both with the foreign molecules and with the translational and rotational degrees of freedom of the complex excited molecules themselves. An improved expression is obtained for the accommodation coefficient and it is applied to the data reported in earlier work. A.Tybulewicz

539.19

20608 INFRARED BAND INTENSITIES IN MULTIATOMIC MOLECULES.

L.M.Sverdlov.

Optika i Spektrosk., Vol. 9, No. 1, 40-5 (July, 1960). In Russian.

Identical structural units (groups) produce "characteristic" vibrations whose frequencies, forms and intensities are similar or identical in molecules of different structure. The present paper discusses the "characteristic" infrared absorption band intensities of normal vibrations in multiatomic molecules. A.Tybulewicz

539.9

20609 THE THEORY OF SCATTERING BY A RIGID ROTATOR.

A.M.Arthurs and A.Dalgarno.

Proc. Roy. Soc. A, Vol. 256, 540-51 (July 19, 1960).

A theory of scattering by a rigid rotator e.g. a diatomic molecule in which the coupling between the different energy levels of the rotator is taken into account is formulated and explicit expressions, which do not depend upon the magnetic quantum numbers, are obtained for various elastic and inelastic cross-sections. Several approximations are described, particular attention being paid to the scattering of heavy particles for which it is shown that at low temperatures the orientation-dependent part of the interaction may be more important than the spherically symmetric part. The scattering of low-energy electrons is also investigated and some representative equations are integrated numerically to illustrate the effect of the orientation dependence.

539.19

20610 MOLECULAR MODEL CALCULATIONS WITH ELECTRONIC CALCULATING MACHINES. I. THEORY AND PROGRAMMING.

E.W.Schmid.

Z. Elektrochem., Vol. 64, No. 4, 533-41 (1960). In German.

An outline is given of the modern theory of molecular vibrations with block diagrams of the programmes for calculations on the P.E.R.M. computer at Munich. These are: (a) simple calculations using known force constants or those taken from a known similar simple model; (b) iterative calculations using perturbation methods to obtain force constants which give the best least squares fit between observed and calculated frequencies. R.G.C.Arridge

539.19 : 523.6

20611 THE MEAN LIFE OF THE ROTATIONAL STATES OF THE GROUND STATE OF THE CN MOLECULE.

J.Hunaerts.

Ann. Astrophys., Vol. 22, No. 6, 812-19 (1959). In French.

The interpretation of the spectrum of Comet Whipple—Fedtke—Tevzadze 1943 I (1942 g) enables the determination of the mean life of the rotational states of the ground electronic state of CN. The values 10 h 22 m and 8 h 36 m obtained respectively in the first excited levels J'' = 1.5 of the F_1'' and F_2'' states are greater than for the hydrides. The general behaviour of the CN band with heliocentric distance has been established.

539.19 : 523.77

EXCITATION TEMPERATURES FOR THE CN EMISSION FROM THE LOW CHROMOSPHERE.

See Abstr. 18775

539.19

20612 THE RENNER EFFECT AND SPIN—ORBIT COUPLING.

J.A.Pople.

Molecular Phys., Vol. 3, No. 1, 16-22 (Jan., 1960).

The Renner theory of vibrational—electronic interaction in linear triatomic molecules in Π electronic states is extended to take account of coupling between an odd electron spin and the electron orbital angular momentum. Perturbation expressions for the splittings and shifts of energy levels are obtained on the assumption that the Renner splittings and the spin—orbit coupling energy are of the same order of magnitude, but less than the energy quantum of the bending vibrations.

539.19

20613 CERTAIN PROBLEMS IN THE SPECTROSCOPY OF COMPLEX MOLECULES. S.I.Kubarev.

Optika i Spektrosk., Vol. 9, No. 1, 3-6 (July, 1960). In Russian.

A complex molecule is defined as a multiatomic molecule in which the degree of coupling between normal vibrations is sufficient to produce continuous distribution of vibrational energies. It is shown that the oscillator approximation explains satisfactorily the observed temperature dependence of the band parameters, such as width, of complex molecules. A.Tybulewicz

539.19

20614 THE WIDTH AND PROFILE OF INFRARED ABSORPTION BANDS. G.G.Petrash.

Optika i Spektrosk., Vol. 9, No. 1, 121-3 (July, 1960). In Russian.

The following infrared bands were recorded very carefully (practically without any systematic errors): 1008 cm^{-1} of solid naphthalene, 1030.7, 1147.4, 1217.6 cm^{-1} of pyridine, 903 cm^{-1} of cyclohexane, 1036.8 cm^{-1} of benzene and 918 cm^{-1} of acetonitrile. The results showed that only the 903 and 1147.4 cm^{-1} bands had simple profiles which agreed well with the dispersion formula. These two bands can be used to estimate distortions of infrared spectra by optical instruments. A.Tybulewicz

539.19

20615 EMISSION SPECTRUM OF CHLORINE EXCITED IN THE PRESENCE OF ARGON. I. THE BAND SYSTEM IN THE REGION 2600-2390 Å. P.Venkateswarlu and B.N.Khanna.

Proc. Indian Acad. Sci. A, Vol. 49, No. 2, 117-27 (Feb., 1959).

The spectrum was photographed with a 21 ft grating spectrograph in the first order. Two band systems in the region 2600-2390 A and 2365-2239 A were observed which appear to be analogous to the 2950-2670 A and 2660-2590 A systems respectively of bromine reported by Venkateswarlu and Verma (Abstr. 952-3 of 1958). The wavelengths and the wave-numbers of all the bands in the system 2600-2390 A are given. The vibrational scheme, along with the corresponding Franck—Condon parabola, is also given. The analysis suggests that the lower state of the system is the $3\pi(O_u^+)$ state established by Elliott (1937) at 17 658 cm^{-1} and that the upper state is at 57 773 cm^{-1}. The vibrational constants obtained are $\omega_0' = 246.6\ \text{cm}^{-1}$, $\omega_0' x_0' = 0.615\ \text{cm}^{-1}$, $\omega_0'' = 255.2\ \text{cm}^{-1}$, $\omega_0'' x_0'' = 5.5\ \text{cm}^{-1}$, $\omega_0'' y_0'' = 0.0155\ \text{cm}^{-1}$ and $\omega_0'' z_0'' = 0.001\,15\ \text{cm}^{-1}$.

539.19

20616 EMISSION SPECTRUM OF CHLORINE EXCITED IN THE PRESENCE OF ARGON. II. THE BAND SYSTEM IN THE REGION 2365-2239 Å. B.N.Khanna.

Proc. Indian Acad. Sci. A, Vol. 49, No. 5, 293-301 (May, 1959).

The weak band system in the region 2365-2239 A is discussed. The wavelengths and the wave-numbers of the bands photographed in the first order of a 21 ft grating spectrograph are given. The vibrational analysis of the bands and their corresponding intensity distribution are presented. The analysis shows that the lower state of the system is the same as that of the 2600-2390 A system discussed in Pt I, and is the $3\pi(O_u^+)$ state established by Elliott at 17 658 cm^{-1}. The constants of the upper state are $\omega_0' = 261.5\ \text{cm}^{-1}$, $\omega_0' x_0' = 0.812\ \text{cm}^{-1}$, $T_0 = 61\,290\ \text{cm}^{-1}$.

53

20617 THE RADIO-FREQUENCY SPECTRUM OF H_2^+.

B.F.Burke.

Astrophys. J., Vol. 132, No. 2, 514-15 (Sept., 1960).

Gives results of the calculation of the fine and hyperfine structure of the lowest excited rotational level. J.Hawg

539

20618 ROTATIONAL ANALYSIS OF THE BANDS (0,0) AND (1,0) OF THE RED SYSTEM OF CN. M.Rigutti.

Mem. Soc. Astron. Ital., Vol. 30, No. 3-4, 325-32 (1960). In Ital

Wavelengths (in air) of 569 lines belonging to the (0,0) and (1 bands of the red system of CN and provisional rotational constan of $A^2\Pi$ and $X^2\Sigma$ states are given.

539

20619 BAND SYSTEMS $B(^2\Sigma^+) \rightarrow X(^2\Sigma^+)$ AND DISSOCIATION VALUES OF THE RADICALS HgI AND HgBr.

K.Wieland.

Z. Elektrochem., Vol. 64, No. 5, 761-9 (1960). In German.

Emission spectra in the region 4000-5000 A were photograph Wave-numbers are tabulated, together with estimated intensities, assigned values of v' and v'', and differences (small) from the calculated wave-numbers. Dissociation energies are given; they the smallest of the values for all group II halides. G.F.Loth

539.

20620 INFRARED SPECTRA OF LITHIUM HALIDE MONOMERS.

W.Klemperer, W.G.Norris, A.Büchler and A.G.Emslie.

J. chem. Phys., Vol. 33, No. 5, 1534-40 (Nov., 1960).

The infrared spectra of the lithium halides were re-examine The vibrational constants of the diatomic molecules are

LiCl	$\omega_e = 641 \pm 3$	$\omega_e x_e = 4.2 \pm 0.3$	
LiBr	$\omega_e = 563.2 \pm 0.2$	$\omega_e x_e = 3.53 \pm 0.15$	$\omega_e y_e = 0.02 \pm 0.03$
LiI	$\omega_e = 498.2 \pm 0.2$	$\omega_e x_e = 3.39 \pm 0.15$	$\omega_e y_e = 0.08 \pm 0.03$

The first five coefficients of the Dunham expansion of the potenti energy were obtained for lithium bromide and iodide. Rittner's ionic model was found to give a good representation of the potenti energy. The ionic-model treatment of the lithium halides is extended to take account of the higher multipole polarizabilities of the halide ions. The introduction of quadrupole and higher polarizabilities destroys the agreement between observed and calculated spectroscopic constants which is found when only dipole pol rizabilities are used.

539

20621 PRESSURE DEPENDENCE OF SOME INFRARED AN VACUUM ULTRAVIOLET BANDS OCCURRING IN ACTIVE NITROGEN. R.A.Young.

J. chem. Phys., Vol. 33, No. 4, 1112-16 (Oct., 1960).

By comparing the infrared (7000 to 11 000 A) and vacuum ult violet (1050 to 1350 A) nitrogen afterglow emission to the visible (5300 to 6500 A) afterglow it has been determined that: (1) all the portions of the afterglow spectrum decay identically with time; (2) the predominant emission in the vacuum ultraviolet between 1 and 1350 A may be attributed to the Lyman—Birge—Hopfield band from the 6, 5, 4 vibration levels and that the population of these levels is collisionally deactivated by molecular nitrogen with a p bability of 1×10^{-2}/collision; and (3) that apparently half the inte sity of the first positive infrared bands with $v' < 6$ are excited through an intermediate state or complex whose lifetime is no shorter than 10^{-7} sec and which, in the absence of collisions, doe not contribute to the emission in the regions between 1050 and 11 000 A that have been monitored.

53

20622 INTERPRETATION OF INTENSITY DISTRIBUTIONS IN THE N_2 LYMAN—BIRGE—HOPFIELD AND CO FOURTH POSITIVE BAND SYSTEMS. R.W.Nicholls.

Nature (London), Vol. 186, 958-9 (June 18, 1960).

Analysis of eye estimates of intensities of bands of the two systems leads to the belief that the electronic transition moment each system may be substantially independent of internuclear se tion. Thus Franck—Condon factors are probably a good measure relative vibrational transition probabilities in each case.

R.W.Nic

539.19

523 MAGNETIC ROTATION SPECTRA OF NITRIC OXIDE IN THE NEAR INFRARED. G.A.Mann and C.D.Hause.

em. Phys., Vol. 33, No. 4, 1117-23 (Oct., 1960).

lagnetic rotation spectra of the 3—0 band at 1.8 μ and a portion 2—0 band at 2.7 μ of nitric oxide were observed and recorded. ions in excess of 10^0 in fields of 2400 gauss were observed in cases. The P and R branch lines arising from the $^2\Pi_{1/2}$ states negative rotation (counter clockwise when looking against the nt light) while the P and R branches from the $^2\Pi_{3/2}$ states positive rotation. The Q branch signals are more complex oth positive and negative rotations are observed. Certain alies in the magnetic rotation spectrum of the 3—0 band are .

539.19

0624 SPECTRUM OF ReF_6.

J.C.Eisenstein.

iem. Phys., Vol. 33, No. 5, 1530-1 (Nov., 1960).

The value of the spin—orbit coupling constant, ζ, for Re^{6+} in is discussed. Moffitt et al. have tentatively assigned a value cm^{-1} to ζ for the series of compounds from ReF_6 to PtF_6. How- , a detailed analysis of the OsF_6 and IrF_6 spectra indicates that values near 3200 and 3700 cm^{-1} for these two compounds. ζ increase in the sequence Re, Os, Ir, it is probably smaller 3000 cm^{-1} in ReF_6. If one assumes that there is a Jahn— er distortion of the fluorine octahedron, the optical absorption on ReF_6 can be reconciled with this smaller value of ζ.

539.19

0625 OBSERVATIONS ON THE INFRARED ABSORPTION SPECTRA AND STRUCTURE OF METALLIC ENATES. C.Duval and J.Lecomte.

lektrochem., Vol. 64, No. 5, 582-6 (1960). In French.

Transmission studies (220-3500 cm^{-1}) of eleven metallic nates in powder form reveal that the selenate ion $(SeO_4)^{2-}$ has gular tetrahedral structure. The unit cell of the selenates is determined. The spectra indicate the presence of small amounts id selenates, and in beryllium selenate, the presence of some c salt. D.L.Greenaway

539.19

0626 VIBRATIONAL SPECTRA OF PENTA-DEUTERO-FLUORO-BENZENE.

eele, E.R.Lippincott and J.Xavier.

iem. Phys., Vol. 33, No. 4, 1242-7 (Oct., 1960).

The infrared and Raman spectra were measured and a set of gnments for the vibrational fundamentals is proposed. These shown to be consistent with the present assignments of F, C_6D_6, and C_6D_5H by application of the product and inequality s.

539.19

0627 MICROWAVE SPECTRUM, STRUCTURE AND INTERNAL ROTATION BARRIER OF DIMETHYL SULPHIDE.

.Rudolph, H.Dreizler and W.Maier.

laturforsch., Vol. 15a, No. 8, 742 (Aug., 1960). In German.

Twenty nine of the many lines observed in the range from 8 to c/s are assigned to rotational transitions of an asymmetric rotor. rotational constants (in Mc/s) A = 17 809.39, B = 7 621.00 and 5 717.80 are derived from low-J transitions for which centrifugal ortions are negligible. With the assumptions that $\angle HCH \doteq 109^\circ 28'$ that the methyl groups are symmetric about the CS directions, parameters $\angle CSC = 98^\circ 58' \pm 0.3^\circ$, $d_{SC} = 1.809A \pm 0.005A$ and $_I = 1.083A \pm 0.01A$ are derived, the possibe errors allowing for sonable departures from the assumed conditions. Internal rota- splits several lines into resolvable close triplets, from the arations of which, with existing theory (Abstr. 4212 of 1960), the rier to rotation of each methyl group is calculated to be ± 0.1 kcal/mole, allowance again being made for some inaccuracy ne assumed structure. J.Sheridan

539.19

0628 ANOMALOUS STARK EFFECTS IN THE MILLIMETRE WAVE SPECTRUM OF FORMYL FLUORIDE.

avero and J.G.Baker.

vo Cimento, Vol. 17, No. 5, 734-9 (Sept. 1, 1960).

Measurements of Stark effects in the rotational spectra of nyl and d-formyl fluoride show the presence of anomalous com- ents that vary in strength with the field. They occur predominantly at high fields and may possibly be a molecular polarizability effect. In addition the normal molecular dipole moment is found to be (1.99 ± 0.03) D, oriented almost parallel to the C—H bond and at an angle of 79° to the C—F bond. This is discussed in connection with the molecular structure.

539.19

20629 CENTRIFUGAL EFFECTS IN MILLIMETRE WAVE SPECTRA: FORMYL FLUORIDE.

P.Favero, A.M.Mirri and J.G.Baker.

Nuovo Cimento, Vol. 17, No. 5, 740-8 (Sept. 1, 1960).

The three rotational and six distortion constants of both formyl and d-formyl fluoride were determined from their millimetre wave absorption spectra, using an improved method of calculation of centrifugal effects. The rotational constants are: for HCOF, A = 91 156.56 Mc/s, B = 11 760.23 Mc/s, C = 10 396.72 Mc/s; for DCOF, A = 65 093.59 Mc/s, B = 11 761.74 Mc/s, C = 9 941.71 Mc/s. Taken with electron diffraction data these yield the parameters $r_{CH} = (1.087 \pm 0.01)A$, $r_{CO} = (1.182 \pm 0.003)A$, $r_{CF} = (1.341 \pm 0.003)$ A, and $\beta_{FCO} = (123.04 \pm 0.02)^\circ$. Comparisons are made with the structure of the formyl grouping in similar molecules.

539.19

20630 MICROWAVE SPECTRUM, BARRIER TO INTERNAL ROTATION, AND QUADRUPOLE COUPLING OF ACETYL BROMIDE. L.C.Krisher.

J. chem. Phys., Vol. 33, No. 4, 1237-41 (Oct., 1960).

The microwave spectra of the two acetyl bromide species, CH_3COBr^{79} and CH_3COBr^{81}, were investigated in the region 12 000 to 33 000 Mc/s. The bromine nuclear quadrupole hyperfine splittings were analysed to give values for the quadrupole coupling constants. The observed coupling constants indicate a considerable deviation from cylindrical symmetry of the electric field gradient about the C—Br bond. Several of the rotational transitions were further split into doublets due to the hindered internal rotation of the methyl group. The quadrupole hyperfine and internal rotation splittings were found to be essentially independent, and analysis of the latter gives a barrier to internal rotation of 1305 ± 30 cal/mole.

539.19

20631 SPECTROPHOTOMETRIC STUDIES OF QUINOXALINE 2,3 DITHIOL AND ITS CHELATE COMPOUNDS WITH NICKEL (II), COBALT (II) AND PALLADIUM (II).

D.B.Stevančević and V.G.Dražić.

Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 9, 69-76 (March, 1959).

Absorption spectra of quinoxaline 2, 3 dithiol and its chelate compounds are given. By Job's method of continuous variations and by the molar ratio method the metal to ligand ratios are determined and a possible structure of the chelates are proposed.

539.19

20632 PERTURBATION OF LINES OF THE VIBRATION—ROTATION BAND OF HYDROFLUORIC GAS IN THE PRESENCE OF COMPRESSED RARE GASES.

B.Oksengorn and B.Vodar.

C.R. Acad. Sci. (Paris), Vol. 251, No. 3, 361-3 (July 18, 1960). In French.

The perturbation of the rotation lines of the P and R branches of the HF molecule, in the presence of argon, krypton and xenon, is determined on a Perkin—Elmer spectrometer at 20°C. Results are discussed and compared with those calculated from a statistical theory. G.I.W.Llewelyn

539.19

20633 ATTEMPT AT THE INTERPRETATION OF THE ROTATIONAL LINES OF THE VIBRATION—ROTATION SPECTRUM OF A DIATOMIC MOLECULE PERTURBED BY ATOMS OF FOREIGN GAS. F.Schuller and B.Oksengorn.

C.R. Acad. Sci. (Paris), Vol. 251, No. 4, 541-3 (July 25, 1960). In French.

The rigid rotator approximation leads to symmetrical displacements of the R and P branches, contrary to what is observed experimentally for HF (see preceding abstract). It appears that the dominant term arises from the interaction of rotation and vibration. R.F.Barrow

539.19

20634 INFRARED SPECTRA OF ALKYLDIBORANES. III. 1,2-DIMETHYL- AND 1,2-DIETHYLDIBORANES.

W.J.Lehmann, C.O.Wilson, Jr and I.Shapiro.

J. chem. Phys., Vol. 33, No. 2, 590-7 (Aug., 1960).

For Pts I-II, see Abstr. 7760, 15732 of 1960. The infrared spectra of three isotopic variants of 1,2-dimethyldiborane—$(CH_3B^{10}H_2)_2$, $(CH_3BH_2)_2$, $(CH_3BD_2)_2$—and of five 1,2-diethyldiboranes—$(C_2H_5B^{10}H_2)_2$, $(C_2H_5BH_2)_2$, $(C_2H_5BD_2)_2$, $(C_2D_5BH_2)_2$, $(C_2D_5BD_2)_2$— are reported and frequency assignments are made. 1,2-Dialkyldiboranes are very stable with respect to decomposition, but on prolonged standing rearrange to 1,1-dialkyldiboranes. Appearance of absorptions at ~2100 and 1550 cm^{-1} is the first indication of the presence of 1,1-dialkyldiborane impurity. Although not conclusive, the evidence favours existence of predominantly cis configurations.

539.19

20635 FAR INFRARED SPECTRUM AND STRUCTURE OF DISILOXANE.

J.R.Aronson, R.C.Lord and D.W.Robinson.

J. chem. Phys., Vol. 33, No. 4, 1004-7 (Oct., 1960).

Study of the infrared absorption of gaseous disiloxane in the range 50-150 cm^{-1} shows that significant absorption is confined to the lower part of the range. A broad band with five rather flat maxima at about 56.4, 69.2 80.1, 90.5, and 100 cm^{-1} is interpreted as the spectrum of the mixed vibrational and rotational transitions of a quasilinear triatomic molecule. The consequences of this model of disiloxane for the vibrational spectra of the molecule at higher frequencies are discussed and various unusual features of the spectra explained on the basis of the model.

539.19

20636 THE JAHN—TELLER EFFECT IN MANGANIC ACETYLACETONATE. A.Forman and L.E.Orgel.

Molecular Phys., Vol. 2, No. 4, 362-6 (Oct., 1959).

The infrared spectra of the tris-acetylacetonates of chromium, manganese, iron and aluminium were measured as far as 400 cm^{-1}. The nature of the bands due to vibrations involving motion of the oxygen atoms relative to the metal is consistent with the operation of the Jahn—Teller mechanism in the manganic compound.

539.19

20637 SOME TEMPERATURE DEPENDENT EFFECTS ON THE OPTICAL ABSORPTION LINE SHAPE OF PARAMAGNETIC IONS. R.Englman.

Molecular Phys., Vol. 3, No. 1, 23-34 (Jan., 1960).

The temperature variations of the total intensity and of the mean energy of optical absorption in hydrated paramagnetic salts are calculated on the assumption that the absorbing ion and its coordinated ligands form an isolated complex. These calculations take into account the anharmonicities in the vibrational motion of the ligands. Comparison with experimental data indicates a rather large amount of anharmonicity.

539.19

20638 CHARGE TRANSFER STATES AND OPTICAL ABSORPTION IN OCTAHEDRALLY HYDRATED PARAMAGNETIC SALTS. R.Englman.

Molecular Phys., Vol. 3, No. 1, 48-58 (Jan., 1960).

A comprehensive theory is given for all observed optical absorptions which do not involve a spin-change in the paramagnetic ion. Except for the anomalous behaviour of the vanadous ion, good agreement is found between the calculated and the observed oscillator strengths. The operative mechanism in the absorption is the vibrational motion of the ligands, enabling virtual transitions to odd-parity charge transfer states to take place. In these states the central ion loses an electron to the ligands; this situation is also analysed in the paper.

539.19 : 539.18

20639 THE Si Kβ-BANDS OF THE X-RAY EMISSION SPECTRA OF ELEMENTARY Si, SiC AND SiO_2. B.Kern.

Z. Phys., Vol. 159, No. 2, 178-93 (1960). In German.

The Si Kβ-emission bands of silicon, carborundum and quartz, hitherto unknown or known inaccurately, were photographed using a high-dispersion focusing spectrograph. The results are presented in the form of photometer curves and in a table giving the energy values for structural features. For all three, all emission bands of the elements concerned are now known. A comparison of the emissions, together with that from diamond, indicates that the spectra essentially represent the form of the energy bands of the valency electrons and that they are little influenced by unusual excited states. The emission bands of silicon, carborundum and diamond show to a great extent similar features, thereby indicating an essentially covalent type of bonding in all cases including carborundum. The emissio forms are in rough agreement with the calculated valency band structures.

539

20640 INTERACTION BETWEEN INTRAMOLECULAR AND INTERMOLECULAR VIBRATIONS IN BROMOFORM.

P.D.Simova.

C.R. Acad. Bulg. Sci., Vol. 13, No. 3, 261-3 (May-June, 1960). In Russian.

Eighteen frequencies (between 153 and 3110 cm^{-1}) were deter mined in the Raman spectrum of $CHBr_3$, six of which are explaine as combinations of intramolecular vibrations with the intermolec ones.

F.Lachn

539

20641 ELECTRONEGATIVITIES FROM COMPARISON OF BOND LENGTHS IN AH AND AH^+. H.A.Bent.

J. chem. Phys., Vol. 33, No. 4, 1258-9 (Oct., 1960).

Ionization of the diatomic hydride, AH, to give AH^+, leads to increase in the internuclear distance if the electronegativity of A exceeds about 2, and the lengthening increases monotonically as t electronegativity of A increases. It is proposed that, as the elect negativity of A increases, ionization from a bonding orbital is inc ingly preferred to that from a non-binding orbital on A. When the electronegativity of A is less than about 2, ionization shortens the bond, but the same trend continues, the shortening being greater t lower the electronegativity of A. To account for the shortenings, is proposed that ionization from a non-bonding orbital on A leads the use of more s-character by A in its bond in AH^+. These regu ities may be used to estimate electronegativities, or to predict unmeasured internuclear distances.

J.Sherid

539.19 : 535

THE INTENSITIES OF RAMAN LINES.
See Abstr. 19413

539

20642 RADIOFREQUENCY SPECTROSCOPY USING THREE LEVEL MASER ACTION. K.Shimoda.

J. Phys. Soc. Japan, Vol. 14, No. 7, 954-9 (July, 1959).

A direct transition between l-type doublets of an OCS molecu was observed either as emission or absorption using the three-le maser action. The pumping radiation was supplied by a klystron 2K33 at the frequency corresponding to $J = 2 \leftarrow 1$, and the l-type doubling transition at 12.78 Mc/s for $J = 1$ was observed by a mo fied Pound—Knight circuit. Generally the low frequency transitio of molecules is shown to be detectable using a bandwidth of about 1 s^{-1}, if the corresponding microwave transition at 24 000 Mc/s has the absorption coefficient larger than 10^{-8} cm^{-1}. The linewidth can possibly be reduced to several kc/s at the sacrifice of sensitivity. The application of this type of spectrometer is also discussed.

539.19 : 537.2 : 5

MICROWAVE ABSORPTION OF DIPHENYL COMPOUNDS IN DILUTE SOLUTION. See Abstr. 19149

539

20643 EFFECT OF COVALENCY ON THE SPIN—ORBIT COUPLING CONSTANT OF TRANSITION METAL ION

T.Murao.

Progr. theor. Phys., Vol. 21, No. 4, 657-9 (April, 1959).

The charge-transfer considerations of Abstr. 8312-13 of 195 2974 of 1955 are applied to explain the experimental trends in the series of ions $[M(H_2O)_6]^{n+}$.

J.Hawgo

539

20644 ON THE CALCULATION OF THE DIAMAGNETIC SUSCEPTIBILITIES OF MOLECULES WITH MULTIP BONDS. C.Courty.

C.R. Acad. Sci. (Paris), Vol. 250, No. 7, 1211-12 (Feb. 15, 1960). In French.

The methods of Abstr. 11188 of 1959 and Abstr. 17719 of 196 are extended to take account of the anisotropy associated with the p orbitals in multiple bonds. The results are as good as those fo single bonds.

J.Hawgo

539

20645 METASTABLE HYDROGEN MOLECULES. W.Lichten.

Phys. Rev., Vol. 120, No. 3, 848-53 (Nov. 1, 1960).

The existence of a metastable electronic state of H_2 has been olished by means of the molecular beam magnetic resonance nique. Observations were made of the radiofrequency Zeeman trum of natural and para-hydrogen. At a magnetic field of t 5 G the strongest line corresponds to a g-value of 0.83. The arance potential for this line is 11.9 ± 0.25 eV. Observation e quadratic Zeeman effect made it possible to estimate the fine cture of the N = 2 level of para-hydrogen. The observed inter- are: f(J = 2 ↔ J = 3) = 5730 ± 200 Mc/s, f(J = 2 ↔ J = 1) = 00 ± 200 Mc/s. This represents the first complete resolution e fine structure of a rotational level of H_2. Knowledge of the tronic structure of H_2, agreement of the appearance potential spectroscopic data, agreement of the fine structure with ially resolved optical spectra, and good agreement of the Zeeman tra with theory lead to the conclusion that the metastable state t be H_2, $c(1\sigma_g, 1\pi_u)\,^3\Pi_u$.

539.19 : 539.18

0646 NATURE OF THE LIGHT EMISSION BY HYDROGEN IONS. M.Sakuntala and A.von Engel.

ectronics and Control, Vol. 9, No. 1, 31-40 (July, 1960).

Light produced by positive ion beams in their parent gas consists displaced broadened lines orginating from atoms with thermal city and displaced lines forming the Doppler band from atoms velocity components parallel to the beam. The intensity distri- n in the Doppler band shows maxima which correspond to beam cities of the various ion species. A region of zero intensity ts between an undisplaced line and the red end of the associated ler band. A study of the Doppler band gives the clue to the sion process which — it is suggested — is caused by charge sfer collisions leading to dissociation of a "compound molecule", of the dissociation products being an excited atom. An estimate ade of the average cross-section in hydrogen which produces the rved photographic density of the spectrogram. This gives a imum value of ≤ 10^{-19} cm^2, which is of the same order of magni- as the excitation cross section of positive ions in their parent From the position of the maxima on the wavelength scale it ws that the ions involved are H^+, H_2^+, H_3^+ and possibly H_4^+. The ge in light intensity in the Doppler band with cathode fall or gas ssure appears to result from the variation of the number distrib- n of ions of different mass and energy, and the energy dependent ge transfer cross section. To test these conclusions simultaneous surements of the light intensity in the Doppler band, the mass trum of the ions and the ion current distributions would be ded.

539.19

20647 THE HYPERFINE STRUCTURE OF THE HYDROGEN MOLECULAR ION.

algarno, T.N.L.Patterson and W.B.Somerville.

c. Roy. Soc. A, Vol. 259, 100-9 (Nov. 22, 1960).

A calculation is presented of the energy levels of the hydrogen ecular ion in the ground state for different orientations of the tron spin, taking into account the coupling of the electron spin he nuclear spin and to the nuclear rotational angular momentum. first-order coupling terms are evaluated to very high accuracy, quantitative results are given for the level splitting for a number otational levels.

539.19

20648 CORRELATIONS BETWEEN THE ELECTRONIC SPECTRA OF ALTERNANT HYDROCARBON MOLE- LES AND THEIR MONO- AND DI-VALENT IONS. I. BENZENE, RONENE AND TRIPHENYLENE. G.J.Hoijtink.

ecular Phys., Vol. 2, No. 1, 85-95 (Jan., 1959).

A comparison is made between the π-electron transitions in benzene molecule and its mono- and di-valent ions following ASMO-treatment of Pariser and Parr (Abstr. 3508, 5636 of 3; 4555 of 1956). Starting from this theoretical treatment the erimental spectra of the molecules and negative ions of coro- e and triphenylene have been interpreted. The locations of the orption bands are in good agreement with the theoretical expec- ons; the intensity rules, however, are strongly violated. This ergence between theory and experiment is probably due to a n—Teller distortion.

539.19

20649 THE PAIRING OF ELECTRONIC STATES IN ALTERNANT HYDROCARBONS. A.D.McLachlan.

lecular Phys., Vol. 2, No. 3, 271-84 (July, 1959).

The pairing of Hückel molecular orbitals in an alternant hydro- rbon holds in a more general sense for wave-functions which make complete allowance for the correlation of π electrons within the atomic orbital scheme. The new pairing property holds exactly in the scope of Pariser, Parr, and Pople's approximations [Abstr. 3508, 5636 of 1953; Trans Faraday Soc., Vol. 51, 600 (1955)], and leads to an exact correspondence between every detail of the excited states, the electronic spectra and electron resonance spectra of positive and negative hydrocarbon ions. Neutral molecules have a half-filled electron shell in which electrons and holes are on an equal footing. This causes the electron distribution to be uniform in every electronic state, and leads to two kinds of excited state — "even" and "odd" — as Pariser first suggested. Transitions between states of the same parity are forbidden. In neutral radicals the spin density vanishes in all the bonds, and in both radicals and molecules the bond orders vanish between atoms of the same set (starred or unstarred).

539.19

20650 ELECTRON TRANSFER SPECTRA OF HEXAHALIDE COMPLEXES. C.K.Jørgensen.

Molecular Phys., Vol. 2, No. 3, 309-32 (July, 1959).

The electron transfer spectra of the chloro, bromo, and iodo complexes of Ru(III), Ru(IV), Rh(III), Pd(IV), Sn(IV), Sb(V), W(VI), Re(IV), Os(III), Os(IV), Ir(III), Ir(IV), Pt(IV), and Pb(IV) were studied and interpreted by group-theoretical methods as transitions of π (and at higher wave-numbers, σ) electrons, mainly localized in the ligands, to the available orbitals of even parity γ_5, γ_3 and γ_1, representing mainly d, d, and s electrons of the central ion. The half-widths and intensities of the bands support the identification. The remarkable similarity between the spectra of d^4 and d^5 systems with the same set of ligands is explained by the presences of only one effective excited state of the central ion. The structure expected of the group of π transfer bands as function of increasing Landé parameter ζ_{np} of the halogen is calculated. The use of pure molecular orbital (MO) configurations as a convenient classification (but not a very good approximation to the wave-function) is compared to the analogous case of atomic spectroscopy. It is recommended to estimate the MO energies from absorption spectra rather than to try to calculate them from unreliable approximations. 54 refs.

539.19 : 537.533

ENERGY LOSSES OF ELECTRONS TRAVERSING VARIOUS GASES. EXCITED ELECTRONIC STATES OF GAS MOLECULES.

See Abstr. 19764

539.19

20651 THE INFLUENCE OF PARAMAGNETIC MOLECULES ON SINGLET—TRIPLET TRANSITIONS. G.J.Hoijtink.

Molecular Phys., Vol. 3, No. 1, 67-70 (Jan., 1960).

It is shown that singlet—triplet transitions may obtain a finite probability when exchange interaction occurs between the absorbing molecule and a paramagnetic molecule. According to this mechanism no quantitative relation exists between the transition dipole strength and the paramagnetic susceptibility of the perturbing molecule.

539.19

20652 CALCULATION OF THE POLARIZABILITY OF CONJUGATED MOLECULES, WITH ALLOWANCE FOR THE ELECTROSTATIC INTERACTIONS OF π-ELECTRONS.

T.K.Rebane.

Optika i Spektrosk., Vol. 8, No. 4, 458-64 (April, 1960). In Russian.

Considers the effect of the electrostatic interaction of π-electrons on the polarizability of molecules with conjugated single and double bonds. The theory developed is applied to molecules of ethylene and benzene with simplifying assumptions used in the semi-empirical variant of the self-consistent molecular-orbit method. It is found that the electrostatic interaction of π-electrons lowers considerably the polarizability of conjugated molecules, which may also be altered by the interactions of π-electrons with, say σ-electrons.

A.Tybulewicz

539.19

20653 THE INTEGRAL FORMULAE FOR THE VARIATIONAL SOLUTION OF THE MOLECULAR MANY-ELECTRON WAVE EQUATION IN TERMS OF GAUSSIAN FUNCTIONS WITH DIRECT ELECTRONIC CORRELATION. S.F.Boys.

Proc. Roy. Soc. A, Vol. 258, 402-11 (Oct. 25, 1960).

Some years ago the author proved that explicit formulae could be obtained for all the many-dimensional integrals occurring in variational solutions of Schrödinger's many-electron equation for molecules if the expansion functions are constructed from factors of polynomials and radial Gaussian functions about any centres. These have been applied both directly and indirectly in calculations on molecular structure. An extension to this analysis is now reported and it is shown that if any factors of the form $\exp(-cr_{ij})$ are included in the expansion functions, there are explicit formulae for all the necessary many-dimensional integrals. This will make possible both direct and indirect calculations with a more powerful class of expansion functions which appear as if they may give faster convergence for the hitherto very troublesome electronic correlation aspects of many-dimensional wave-functions.

539.19

20654 THE USE OF GAUSSIAN (EXPONENTIAL QUADRATIC) WAVE-FUNCTIONS IN MOLECULAR PROBLEMS.
I. GENERAL FORMULAE FOR THE EVALUATION OF INTEGRALS.

K.Singer.

Proc. Roy. Soc. A, Vol. 258, 412-20 (Oct. 25, 1960).

It is shown that for wave-functions of the form $\Psi = \sum_k C_k \exp(-Q_k)$, where Q_k is any positive definite quadratic form in the Cartesian coordinates of n particles and C_k a constant, all integrals required for the calculation of the electronic energy of molecules by the variation method can be readily evaluated. The potential energy integrals are reduced to quadratures and the other integrals are expressed in closed form. In the general case the quadratic forms Q_k determine many-electron functions formed from correlated electron orbitals of ellipsoidal symmetry and with variable centres. The results are easily extended to wave-functions of the form $\Psi = \sum_k P_k \exp(-Q_k)$, where P_k is a polynomial.

539.19

20655 THE USE OF GAUSSIAN (EXPONENTIAL QUADRATIC) WAVE-FUNCTIONS IN MOLECULAR PROBLEMS.
II. WAVE-FUNCTIONS FOR THE GROUND STATES OF THE HYDROGEN ATOM AND OF THE HYDROGEN MOLECULE.

J.V.L.Longstaff and K.Singer.

Proc. Roy. Soc. A, Vol. 258, 421-30 (Oct. 25, 1960).

The results reported in this paper constitute a first examination of the use of Gaussian wave-functions with correlation as approximations to electronic wave-functions. Functions of the form $\sum_{k=1}^{k=n} C_k \exp(-Q_k)$, where C_k is a constant and Q_k is a quadratic form corresponding to orbitals with cylindrical symmetry, variable centres and with correlation, are used for the hydrogen molecule. Binding energies of 4.30, 4.42, 4.52 and 4.58 eV are obtained with functions containing, respectively, 26, 35, 53 and 71 independent parameters. The accuracy of the results and the moderate computing times suggest that there is considerable scope for wave-functions of this type. For the hydrogen atom, approximations to the 1s-orbital in terms of $\sum_{k=1}^{k=n} C_k \exp(-a_k r^2)$ are given for n = 3, 4, 5, 6 and 8.

539.19

20656 ABSORPTION SPECTRA OF ACTINIDE COMPOUNDS.

C.K.Jørgensen.

Molecular Phys., Vol. 2, No. 1, 96-108 (Jan., 1959).

From the energy levels of the gaseous ions Ac^{2+}, Th^{3+}, and Th^{2+}, it can safely be extrapolated that the ground electron configuration of all actinide ions with ionic charges at least +3 contains only 5f-electrons outside the emanation shells. This is further supported by the $5f^n \rightarrow 5f^{n-1}6d$ transitions observed in Pa(IV), U(III), Np(III) (though their wave numbers are too high to be measured in U(IV) and Np(IV)). The configuration f^2 has a very characteristic distribution of energy levels between $^3H_4$ and $^3P_2$ with $^1S_0$ as much higher, isolated level. The absorption spectra of U(IV) complexes and of PuF_6 suggest interelectronic repulsion parameters ~ 60% of the values in the corresponding lanthanides, while the Landé factors are about twice as large. This would also explain the recent measurements of Cm(III) complexes, compared to Gd(III). The larger average radius of the 5f-shell causes larger perturbation effects from the ligands than in the lanthanides. The J-values will therefore be distributed between several adjacent, observed energy levels without making the general treatment of the f^n-configurations impossible. The variation with oxidation numbers in isoelectronic series are discussed, e.g. U(III) and Np(IV); Pu(II) and AmF_4; and Am(III) and CmF_4. Band positions are predicted in Bk(III) and BkF_4. Finally, the chemical properties of the actinide elements are discussed, and it is emphasized that no necessary connections exist between the presence of f-electrons and constant trivalency.

539.

20657 ULTRAVIOLET BAND SPECTRA OF THE MOLECUL AuMg.

J.Schiltz.

C.R. Acad. Sci. (Paris), Vol. 251, No. 5, 682-3 (Aug. 1, 1960). In French.

A mixture of Au and Mg, containing over 95% by weight of Au, was vaporized in an atmosphere of argon in a King furnace at temperatures between 1920° K and 2200° K. Absorption spectra were photographed by means of a Hilger medium spectrograph. Three new series of bands were observed in the wavelength regions 3152-3320 A, 2920-3056 A, and 2615-2660 A, and the first of these is definitely attributed to the molecule AuMg. K.A.Thom

539.1

20658 A THEORY FOR THE TRIPLET—TRIPLET ABSORPTION SPECTRA OF PORPHYRINS.

M.Gouterman.

J. chem. Phys., Vol. 33, No. 5, 1523-9 (Nov., 1960).

The triplet excited states of porphin are classified as either singly or doubly excited electron configurations. The latter are discussed in detail in terms of a circular box model with electron interaction plus a perturbation due to the actual molecular shape. The energy and intensity of the triplet—triplet transitions from the lowest triplet to these doubly excited states are predicted to consist of: (1) transitions to a pair of states of energy ~25 000 cm (2) transitions to a group of four states of energy ~20 000 cm^{-1}; an a transition to a state of energy ~18 000 cm^{-1}. The first two group are predicted to share equally an intensity half that of the porphin Soret band, while the last transition is weakly forbidden. The predictions compare reasonably well with experiment. In addition a metastable molecular quintet is predicted, with a transition energy to the lowest triplet state slightly smaller than any observe triplet—triplet transition.

539.1

20659 FROZEN FREE RADICALS.

G.J.Minkoff.

New York/London: Interscience Publishers (1960) ix + 148 pp.

This book presents the basic features of the subject as broug out by recent work and the researches of 30-60 years ago. The first 16 pages give a historical survey, including the work of Dewar and Strutt, and of Vegard and McLennan, and a survey of the fields in which frozen free radicals are of interest. Experimental methods, and the basic principles and requirements of trapping, receive separate chapters, and the book concludes with a group of three chapters dealing respectively with individual ato diatomic and triatomic radicals, and with polyatomic radicals containing carbon. The treatment throughout is lucid, and the book is well illustrated. 243 refs.

539.19 : 536.

FROZEN FREE RADICALS. See Abstr. 19578

539.

20660 NUCLEAR HYPERFINE STRUCTURE OF HYDRAZYL FREE RADICALS.

I.S.Ciccarello, I.Garofano and M.Santangelo.

Nuovo Cimento, Vol. 17, No. 6, 881-6 (Sept. 16, 1960).

To obtain information on the electronic structure of hydrazyl free radicals, the electron spin resonance hyperfine structure of group of such radicals derived from 1-1-diphenyl-2-benzoyl-hydrazyl was investigated as a function of suitable substitutions o atoms or groups at different positions in the benzoylic ring. It wa found that the introduction of a nitric group at an "ortho" position to the carbonyl group causes a change of the spectrum which, on t other hand, is not observed if the same group is introduced at a "para" position. This indicates a considerably larger I.S interact in the former case, as compared with the latter, namely a charge transfer preferentially centred on the ortho positions.

539.

20661 ENVIRONMENTAL PERTURBATIONS ON FOREIGN ATOMS AND MOLECULES IN SOLID ARGON, KRYPT AND XENON.

M.McCarty, Jr and G.W.Robinson.

Molecular Phys., Vol. 2, No. 4, 415-30 (Oct., 1959).

Perturbations which are responsible for the shifts of electron and vibrational spectra of species trapped in a solid are considere in terms of the intermolecular potential which describes interacti between these species and neighbouring atoms. It is shown that in certain instances London's theory can give an adequate approximation to the dispersion energy between an electronically excited species and a rare gas atom. The experimental shifts in the elec-

ic absorption spectra of Hg, NH and C_2 at lattice sites in rare
crystals at 4.2°K are explained quantitatively on the basis of a
nard-Jones (6-12) or (6-8-12) potential between the trapped
ies and the rare gas atoms. The theory does not adequately ex-
n the shifts in those cases where strong angular dependent forces
ering appreciably in the two electronic states are present, data
rapped NH_2 free radicals being presented as a case in point.
interaction of sodium atoms with argon at 4.2°K is very com-
, the data being consistent with multiple trapping sites for the
ms, a large repulsive interaction between the excited state of
um and the rare gas, and apparent removal of the three-fold
tal degeneracy in the excited state by the environmental perturb-
n. The three-fold orbital degeneracy in the $^3P_1$ state of mercury
found also to be removed. The blue shift of 1281 cm^{-1} for the
— $^1S_0$ transition of mercury in solid argon at 4.2°K corresponds
ost exactly with the position of one of the two prominent features
ne spectrum of mercury in argon gas at comparable densities
illustrates the similarity of structure in the two physical states.
interesting perturbations on the vibrational states of NH and C_2
gest a close similarity to the effect which causes environmental
iations of coupling constants for hyperfine interactions in trapped
rogen atoms.

539.19

20662 ELECTRON RESONANCE STUDIES ON THE KINETICS OF FREE RADICAL FORMATION AND REACTION IN
SOLID PHASE. M.Fujimoto and D.J.E.Ingram.

ecular Phys., Vol. 2, No. 4, 341-8 (Oct., 1959).

Detailed measurements were made on the electron resonance
ctra of u.v.-irradiated alcohol—hydrogen peroxide mixtures.
variation of the spectra with both time of irradiation and tempera-
e was followed, and it is concluded that three different radical
cies are formed in the medium. A quantitative analysis of the
wth and decay of these different species is undertaken and it is
wn that there is good agreement with a first-order kinetics of
mation and decay.

539.19

20663 THEORY OF E.S.R. LINEWIDTHS OF FREE RADICALS.
D.Kivelson.

hem. Phys., Vol. 33, No. 4, 1094-106 (Oct., 1960).

A theory of e.s.r. linewidths for substances in which the mag-
c anisotropy is small and for which the orbital magnetism has
n essentially quenched is developed. Nuclear quadrupole
nents, zero field splittings, anisotropic Zeeman terms, and intra-
ecular electron—nuclear dipolar interactions, as well as motion-
nd exchange effects are considered in the strong field case. The
ry is developed in a manner that is particularly adaptable to the
ly of liquids but it is also applied to crystals since the resulting
ations, though only applicable for small anisotropies, are particu-
y simple. The theory provides an extension of previous theories
e.s.r. spectra in liquids. Several applications of the theory are
ussed with particular emphasis on V^{4+} chelates. The theory of
hange in liquids, a phenomenon which is complicated by the non-
mutivity of the motional and exchange Hamiltonians is considered
pecial detail. It is shown that this theory can be used to explain
sser's results — the existence of an optimum viscosity for the
ervation of hyperfine structure.

539.19

20664 POLYCRYSTALLINE RESONANCE LINE SHAPE OF π-ELECTRON RADICALS. H.Sternlicht.

chem. Phys., Vol. 33, No. 4, 1128-32 (Oct., 1960).

A general expression in the form of a multiple integral involving
elta function is derived for the polycrystalline spectra of radi-
s. The expression is exact when the hyperfine structure is due
the interaction of one proton with the unpaired electron. The ex-
sion to a system involving the interaction of a number of protons
h the unpaired electron is straightforward but was not done here.
cause of the formidable integrations encountered when the complete
n Hamiltonian is used, a simpler case is considered to illustrate
technique developed. It is shown that if one assumes that I_H, the
clear spin component along the externally applied magnetic field,
a good quantum number, then the peak-to-peak separation of the
oad doublet that is obtained bears a simple relationship to the
perfine interaction. For a properly chosen Cartesian axis system,
hyperfine spin Hamiltonian can be written as

$$H_{hf} = hA\,S_zI_z + hB\,S_xI_x + hC\,S_yI_y.$$

e peak-to-peak separation corresponds to the middle value of
, |B|, |C|. The line shape for a C–H fragment with the unpaired electron in a carbon $2p_x$ orbital is worked out in detail assuming that I_H is a good quantum number. Two peaks with very slightly asymmetric shoulders are obtained, the peak-to-peak separation being 61 Mc/s.

539.19

20665 THE ELECTRON SPIN RESONANCE SPECTRUM OF A γ-IRRADIATED SINGLE CRYSTAL OF GLYCINE.

D.K.Ghosh and D.H.Whiffen.

Molecular Phys., Vol. 2, No. 3, 285-300 (July, 1959).

It is shown that γ-rays act on glycine to give the free radical NH_3^+-CH-CO_2^- which remains trapped in the solid. Electron spin resonance spectra from an irradiated single glycine crystal show marked anisotropy and it is deduced that the radicals are precisely oriented in the crystal lattice. The symmetry shown by the spectra is consistent with that of the crystal lattice. Despite overlapping of lines, the spectra due to the NH_3^+-CH-CO_2^- radical have been interpreted in terms of electron—nucleus coupling tensors for the N, the $H_{(C)}$ and the three $H_{(N)}$ nuclei, the latter being equivalent by virtue of a rotation or tunnelling of the -NH_3^+ grouping. A qualitative interpretation of these tensors in terms of the electronic structure of the radical is given. This is consistent with the negative spin density on the $H_{(C)}$ atoms and a positive spin density on the $H_{(N)}$ atoms, as predicted by theoretical treatments. The radicals appear to be oriented in the lattice in approximately the same way as their parent molecules.

539.19

20666 AN ELECTRON SPIN RESONANCE STUDY OF A γ-IRRADIATED SINGLE CRYSTAL OF GLYCOLLIC ACID. N.M.Atherton and D.H.Whiffen.

Molecular Phys., Vol. 3, No. 1, 1-15 (Jan., 1960).

Measurements were made of the electron spin resonance spectrum of a γ-irradiated single crystal of glycollic acid as a function of crystal orientation. These confirm that the trapped radicals are carboxy hydroxy methyl radicals, HOCHCOOH. The results are expressed in the form of a spin Hamiltonian which includes a coupling tensor for the hydrogen attached to the central carbon atom and a tensor for the hydroxyl hydrogen. A special feature of the spectra is that the relative intensities of the hyperfine lines are non-integral, and this explained by a derivation of the transition moments which shows that the usual selection rule $\Delta M_I = 0$ is inapplicable to the solid state. The anisotropic g tensor is also evaluated. The tensors are briefly discussed in relation to the orientation of the radicals in the crystal and their electronic structure.

539.19

20667 HYPERFINE STRUCTURE IN THE MICROWAVE SPECTRUM OF WATER. II. EFFECTS OF MAGNETIC INTERACTIONS. D.W.Posener.

Austral. J. Phys. Vol. 13, No. 2, 166-85 (June, 1960).

For Pt I, see Abstr. 4880 of 1959. Further analysis of the hyperfine structure appearing in the observed microwave spectra of HDO and D_2O, taking into account nuclear quadrupole and magnetic dipole interactions, led to a complete determination of the electric field gradient tensor at the hydrogen nuclei in the water molecule, giving a value along the bond direction of (+1.59 ± 0.04) × 10^{16}e.s.u. Parameters describing magnetic effects in the observed spectra were obtained.

539.19

20668 MAGNETIC HYPERFINE SPECTRUM OF H_2CO BY A MASER. H.Takuma, T.Shimizu and K.Shimoda.

J. Phys. Soc. Japan, Vol. 14, No. 11, 1595-9 (Nov., 1959).

The magnetic hyperfine structure in the J = 3, $K_{-1} = 1$, $\Delta J = 0$ transition of formaldehyde at 29 Gc/s was studied by a beam type maser spectrometer. The hyperfine components corresponding to $\Delta F = 0$ transitions were observed with good signal-to-noise ratio. The splittings are measured as 23.0 kc/s and 10.4 kc/s which are compared with theory. As well as the I·J coupling, spin—spin interaction term $I_1 \cdot I_2$ between the two protons is fairly large and cannot be neglected. Coupling constants were determined as $\mu_N^2 g_H^2 r^{3} =$ $= 19.9$ kc/s and $\sum_g \langle J_g^2 \rangle (A_{1g} + A_{2g}) = 54.6$ kc/s.

539.19

20669 NUCLEAR RESONANCE SPECTRUM OF ORTHO BROMOANILINE. S.Clough.

Molecular Phys., Vol. 2, No. 4, 349-56 (Oct., 1959).

The changes produced in the nuclear magnetic resonance spectrum of the ring protons of o-bromoaniline by the addition of acetone are found to be associated almost entirely with the decreased shielding of the proton ortho to the amino group. A series of spectra obtained with different amounts of acetone enables the spectral lines due to the individual protons to be identified and approximate values of the chemical shift and spin—spin coupling parameters to be deduced. These are used as a basis for a series of calculated spectra which progressively yield more accurate values of the parameters and finally a close agreement with the experimental spectrum. The dependence of the varying chemical shift upon acetone concentration is measured and discussed.

539.19

20670 HALOGEN NUCLEAR MAGNETIC RESONANCE SHIFTS. I. Cl^{35} RESONANCE IN ALKALI CHLORIDES.

P.Venkateswarlu and B.D.Nageswara Rao.

Proc. Indian. Acad. Sci. A, Vol. 50, No. 4, 254-8 (Oct., 1959).

Aqueous solutions of alkali chlorides were studied. The shifts probably represent the effect of a neighbouring atom, even in the highly ionic state. The similarity of these results to the quadrupole coupling constants of the halogen atom in these molecules is pointed out.

539.19 : 539.14

NUCLEAR COUPLING OF N^{14} IN NH_3. See Abstr. 20333

539.19

20671 THE UNITED ATOM MODEL OF THE HF MOLECULE.

R.Gáspár and I.Tamássy-Lentei.

Acta. phys. Hungar., Vol. 9, No. 1-2, 105-13 (1958).

Calculation for the HF molecule, based on a united atom model and using one-centre, one-electron eigenfunctions, gives fair agreement with experimental values of dissociation energy and equilibrium nuclear separation. R.C.Seymour

539.19

20672 ESTIMATION OF CHARGE AND TYPE OF CHEMICAL BOND OF OSMIUM IN COMPOUNDS BY L_{III} ABSORPTION SPECTRA.

R.L.Barinsky and E.G.Nadjakov.

C.R. Acad. Bulg. Sci., Vol. 13, No. 1, 31-4 (Jan.-Feb., 1960).

The X-ray absorption spectra of a series of osmium complexes were investigated. Little variation in the effective charge on the osmium atom is encountered with valency change but the bond type changes from covalent in the high-valency states to predominantly ionic in trivalent and divalent osmium. G.I.W.Llewelyn

539.19

20673 STUDY OF MOLECULAR INTEGRALS. I. TWO-CENTER EXCHANGE INTEGRALS.

R.C.Sahni and C.D.LaBudde.

J. chem. Phys., Vol. 33, No. 4, 1015-21 (Oct., 1960).

The evaluation of the two-centre two-electron exchange integrals using prolate spheroidal coordinates and spherical coordinates is discussed. Estimates for the convergence rates of the infinite series which arise when both coordinate systems are used to evaluate the integrals are obtained.

539.19

20674 STUDY OF MOLECULAR INTEGRALS. II. THREE-CENTER ONE-ELECTRON AND TWO-ELECTRON INTEGRALS.

C.D. LaBudde and R.C.Sahni.

J. chem. Phys., Vol. 33, No. 4, 1022-7 (Oct., 1960).

The evaluation of the three-centre one-electron and two-electron integrals using spherical coordinates is discussed. Estimates for the convergence rates of the infinite series which arise in all cases are derived.

539.19 : 539.18

INTER- AND INTRA-ATOMIC CORRELATION ENERGIES AND THEORY OF CORE-POLARIZATION. See Abstr. 20539

539.19

20675 APPLICABILITY OF ROOTHAAN'S SELF-CONSISTENT FIELD THEORY.

S.Huzinaga.

Phys. Rev., Vol. 120, No. 3, 866-71 (Nov. 1, 1960).

Roothaan's open-shell self-consistent field theory (Abstr. 17806 of 1960) is extended in such a way that it can cover a number of important classes of atomic and molecular states which are not included in the range of applicability originally claimed.

539.19

20676 ON THE NON-ORTHOGONALITY PROBLEM IN THE SEMI-EMPIRICAL MO-LCAO METHOD.

G.Del Re.

Nuovo Cimento, Vol. 17, No. 5, 644-64 (Sept. 1, 1960).

An explicit correlation between semi-empirical MO-LCAO calculations for π-systems including and not including overlap is derived and discussed under the assumption that overlap integral when taken into account, are proportional to the corresponding b integrals. It is shown that, so far as atomic charges are concern the introduction of overlap makes practically no difference in the results. On the contrary all other quantities undergo sometimes serious changes. This is shown by means of a few numerical examples; it gives some support to the idea that the practice of neglecting overlap may not be so sound as has been believed.

539

20677 METAL—METAL BONDING IN DICOBALT HEXACARBONYL DIPHENYLACETYLENE.

D.A.Brown.

J. chem. Phys., Vol. 33, No. 4, 1037-46 (Oct., 1960).

The nature of the bonding between the two cobalt atoms in dicobalt hexacarbonyl diphenylacetylene is discussed in terms of simple molecular-orbital theory. It is shown that, in addition to bonding via the π orbitals of the acetylene residue, it is essential to consider direct overlap between the 4p orbitals of the cobalt atoms. Master formulae and numerical tables are derived for th integrals $S(4p_\sigma 4p_\sigma)$, $S(4p_\pi 4p_\pi)$.

539

20678 THREE REMARKS ON MOLECULAR ORBITAL THE OF COMPLEX MOLECULES.

R.G.Parr.

J. chem. Phys., Vol. 33, No. 4, 1184-99 (Oct., 1960).

Three suggestions are made and discussed concerning the generalized Hückel and related methods for treating the quantum chemistry of complex unsaturated molecules: (1) justification for the assumptions of zero overlap and zero differential overlap res in two facts: (a) for many molecules the atomic orbitals in the LCAO molecular orbitals may be replaced by the corresponding orthogonalized atomic orbitals of Löwdin, without effect on the molecular orbitals; (b) integrals involving charge distributions which are products of orthogonalized atomic orbitals are small. (Observations previously made by several authors). (2) Molecule isoelectronic with benzene are conveniently handled making use of molecular orbitals appropriate to the full benzene symmetry, for then deviations from benzene symmetry can be classified and trea systematically using symmetry combinations of basic integrals. (Formulae are given). (3) The two-centre coulomb repulsion integrals, previously dealt with by rather arbitrary semiempirical procedures, may be expanded by multipole expansion methods, leaving the independent multipoles of each atomic orbitals as its defining theoretical or semiempirical characteristics.

539.

20679 THREE-BODY RECOMBINATION OF OXYGEN ATOM

E.Bauer and M.Salkoff.

J. chem. Phys., Vol. 33, No. 4, 1202 8 (Oct., 1960).

A quantum-mechanical perturbed stationary state calculation been made of the rate of three-body recombination of oxygen atom in the presence of an oxygen molecule as third body. The recomb nation is considered to take place into highly vibrationally excited states (v = 9, 10) of the A ${}^3\Sigma_u{}^+$ state of O_2. There are no adjustab parameters in the calculation. For the interaction potential the results used were those obtained in a previous calculation, which were obtained by comparison with experimental measurements of brational relaxation times in oxygen. At temperatures of the ord 300-3000° K, the calculated recombination coefficient into these tw states is of the order $1 - 10 \times 10^{-33}$ cm^6/sec, and agrees to withi better than a factor of three with recent experimental measureme

539.

20680 APPROXIMATE ELECTRONIC ENERGY SURFACES FROM CUSPLESS WAVE FUNCTIONS.

C.E.Wulfman

J. chem. Phys., Vol. 33, No. 5, 1567-76 (Nov., 1960).

The eigenfunctions of a molecular Hamiltonian in which all Coulomb potentials have been replaced by Hooke's law potentials are easily determined. Their electronic parts are essentially single-particle single-centre harmonic oscillator, or Gaussian wave-functions originating at the centre of nuclear charge. An investigation is made to determine the feasibility of using these cuspless base functions in variational calculations of relative molecular electronic energies. It is found that: (a) Addition of Coulombic or delta-function singularities to the Hooke's law pote tials leads to the formation of rigid molecular systems. (b) The Coulomb potentials in 21-26 electron triatomics can be treated as a perturbation upon quadratic potentials. In agreement with experiment it is noted that: (c) Approximately homonuclear (i.e., non de) 8-, 20-, and 40-electron polyatomics are configurationally ble. (d) The molecules CO_2^+, CO_2, N_2O, NCO^-, BO_2^-, N_3^-, and should all be linear. (e) The molecules NO_2^-, O_3, FNO, F_2O, number of excited states of the molecules (D) should all be near. (f) The stable form of nitrous oxide should be N-N-O r than N-O-N. A number of general features of the treatment liscussed and several of its limitations are pointed out. A ation of coefficients required in Clebsch—Gordan expansions oducts of Hermite polynomials is given.

539.19

681 RELATIONSHIP BETWEEN PROTON SHIELDING CONSTANTS AND ELECTRIC DIPOLE MOMENTS IN HYDROGEN HALIDES. H.F.Hameka.

cular Phys., Vol. 2, No. 1, 64-74 (Jan., 1959).

The proton shielding constants of the hydrogen halides have been lated employing a molecular wave-function built from gauge-iant atomic orbitals. Each of the molecular wave-functions ins a single parameter which is determined from the observed e moment. Calculated and experimental values of the shielding tants for HF, HCl, HBr and HI agree to within approximately 10%.

539.19

20682 A DETERMINATION OF THE ELECTRONEGATIVITY PARAMETER IN MOLECULAR ORBITAL CALCULA-NS ON HETERONUCLEAR MOLECULES CONTAINING NITROGEN.

fthus.

ecular Phys., Vol. 2, No. 4, 367-71 (Oct., 1959).

Using the semi-empirical LCAO molecular orbital method, the tronegativity parameter δ for nitrogen has been chosen to give sonable fit between computed and "correct" bond orders for a es of heterocyclic molecules. A δ-value of about 0.9-1.0 has found for nitrogen in six-membered rings, and about 1.8-2.0 pyrrole.

539.19

20683 STERIC FORCES IN HALOGEN-SUBSTITUTED BENZENES. C.A.Coulson and D.Stocker

ecular Phys., Vol. 2, No. 4, 397-406 (Oct., 1959).

Theoretical calculations are made of the non-bonded repulsion rgies between the halogen atoms in the hexa-halogeno-benzenes. theoretical conclusions are compared with the available erimental evidence.

539.19

20684 SOME INVESTIGATIONS IN THE THEORY OF OPEN-SHELL IONS. I. THE SPIN-HAMILTONIAN.

.Griffith.

lecular Phys., Vol. 3, No. 1, 79-89 (Jan., 1960).

It is shown that second-order perturbation theory leads to the al quadratic and bilinear terms in the spin-Hamiltonian for a tially nondegenerate state even when excited states differing in ltiplicity from the ground states are included. The form of the n-Hamiltonian adequate to represent arbitrary splittings of the ound manifold is considered and explicit results given for the fine ructure and for those interactions with nucleus and external gnetic field which are linear in I and H respectively.

539.19

20685 CHARGE-TRANSFER FORCES IN MOLECULAR COMPOUNDS. II. BENZENE–IODINE COMPLEX.

Aono.

ogr. theor. Phys., Vol. 22, No. 3, 313-20 (Sept., 1959).

For Pt I, see Abstr. 13456 of 1960; see also Abstr. 15779 of 60. It is of much interest to inquire whether the structure of the nzene—iodine complex belongs to the symmetry of C_{2v} or C_{6v}. ere the former is called the R (resting) model and the latter the (axial) model. Some recent experiments on the infrared spectra this complex and the observation of the crystalline state of the nzene—bromine complex support the A model of C_{6v} symmetry. ere the author concludes from a theoretical consideration that the model is most probable for the structure of the benzene—iodine mplex. In the A model, the charge transfer takes place from , the molecular orbital (MO) of benzene to $\phi(\sigma_u, 5p)$, the MO of dine. The energy loss of the charge transfer state which is in-olved in adopting the A model instead of the R model, is supplied the "dis-screening effect" and the interaction energy between e no-bond state and the charge-transfer state. This interaction ergy is far larger in the A model than in the R model. The abilization energy, the dipole moment, the charge-transfer spec-rum and the oscillator strength are calculated, and giving fairly od agreement with experiment.

539.19

20686 CONSIDERATION ON NON-ORTHOGONALITY CATASTROPHE IN THE HEITLER–LONDON THEORY. I.

Y.Mizuno and T.Izuyama.

Progr. theor. Phys., Vol. 22, No. 3, 344-50 (Sept., 1959).

It is proved generally and rigorously, that the non-orthogonality catastrophe never arises in the Heitler–London theory of covalent bonding. This treatment may be regarded as a mathematical justification of Van Vleck's objection (Abstr. 1362 of 1936) against Inglis' criticism (Abstr. 3915 of 1934) of the Heitler–London theory.

539.19 : 539.18

20687 LONG-RANGE INTERACTION OF TWO 1s-HYDROGEN ATOMS EXPRESSED IN TERMS OF NATURAL SPIN-ORBITALS. J.O.Hirschfelder and P.O.Löwdin.

Molecular Phys., Vol. 2, No. 3, 229-58 (July, 1959).

The interaction between two hydrogen atoms in their ground state at large separation is treated by means of a variational form of the perturbation theory, which essentially involves the calculation of the reciprocal of the unperturbed matrix by means of successive inversion. A basic set which avoids the continuum is used. The energy of the system of two hydrogen atoms at large separations is found to be

$$E = [-1 - 6.499026/R^6 - 144.8497/R^8 - \dots]e^2/a_0$$

where the separation R is measured in units of a_0. The coefficient of R^{-6} agrees with the calculations of Pauling and Beach (1935) but the coefficient of R^{-8} is quite different from theirs. The wave function is greatly simplified by introducing natural orbitals. If the wave-function is approximated by using only one or two sets of natural orbitals, very little error results in the calculated dispersion energy. Also, it is shown that such an approximation leads to very little error in the mean square deviation of the approximate wave-function from the exact function. This illustrates the theorem that an approximate wave-function composed of n natural orbitals has a smaller mean square deviation from the true function than an approximate wave-function made up from n other sorts of orbitals. An application of long-range intermolecular force calculations to collision theory is also given.

539.19

20688 MICROWAVE SPECTRUM, STRUCTURE, AND DIPOLE MOMENT OF PROPANE. D.R.Lide, Jr.

J. chem. Phys., Vol. 33, No. 5, 1514-18 (Nov., 1960).

The microwave spectrum of ordinary propane and five isotopic species were measured and analysed. The rotational constants of C_3H_8 are 29 207.36, 8446.07, and 7458.98 Mc/s, and the dipole moment is 0.083 ± 0.001 D. In its equilibrium configuration the molecule has C_{2v} symmetry, with both CH_3 groups staggered with respect to the CH_2 group. The complete structure was determined by the substitution method. Important parameters are: r(CC) = 1.526 ± 0.002 A, $\measuredangle$ CCC = 112.4° ± 0.2°; in the CH_2 group, r(CH) = 1.096 ± 0.002 A, $\measuredangle$HCH = 106.1° ± 0.2°; in the CH_3 groups, r(CH) = 1.091 ± 0.010 A, $\measuredangle$HCH = 107.7° ± 1.0°. The influence of zero-point effects on the structure determination is discussed; these are found to be particularly bad for the CH_3 group, probably because of its large vibrational amplitude.

539.19

20689 STRUCTURE OF THE ISOBUTANE MOLECULE; CHANGE OF DIPOLE MOMENT ON ISOTOPIC SUBSTITUTION. D.R.Lide, Jr.

J. chem. Phys., Vol. 33, No. 5, 1519-22 (Nov., 1960).

The microwave spectra of 5 isotopic species of isobutane were measured and analysed. The isobutane molecule is shown to belong to point group C_{3v}. The structural parameters determined by the substitution method are r(CC) = 1.525 A, $\measuredangle$ CCC = 111.15°, r(CH) = = 1.108 A (tertiary), r(CH) = 1.09 – 1.10 A (methyl), $\measuredangle$ HCH = = 107.5° – 109.5°. The structure is compared with that of other hydrocarbons, and it is suggested that a small systematic difference exists between CC distances determined by microwave and electron diffraction methods. Accurate Stark measurements show that the dipole moment of $(CH_3)_3CD$ is 6.5% ± 0.9% higher than that of $(CH_3)_3CH$.

539.19

20690 DETERMINATION OF DIPOLE MOMENTS FROM MEASUREMENTS ON PURE LIQUIDS. C.R.K.Murty.

J. sci. industr. Res., Vol. 18B, No. 7, 268-70 (July, 1960).

Dipole moments were determined for a number of compounds in pure liquid state by measuring the dielectric constant and refractive index. The moments were calculated from the experimental data using Debye, Onsager, Syrkin and Kirkwood equations and the results compared.

539.19

20691 DIPOLE MOMENT OF LITHIUM HYDRIDE.

L.Wharton, L.P.Gold and W.Klemperer.

J. chem. Phys., Vol. 33, No. 4, 1255 (Oct., 1960).

The transition $J = 1, m_J = 0 \rightarrow J = 1, |m_J| = 1$ was measured for lithium hydride in various fields by the molecular beam electric resonance method. For Li^{7}H, the frequencies corresponding to transition range from 3.2 Mc/s at 730 V/cm to 63.6 Mc/s at 3280 V/cm. The field-independent hyperfine structure extends over 240 kc/s. From the second-order Stark splittings, the electric dipole moments of Li^{7}H and Li^{6}H were obtained as 5.882 ± 0.003 D and 5.884 ± 0.003 D respectively, in the ground states. In the first excited vibrational state of Li^{7}H, the moment is slightly greater, 5.990 ± 0.003 D. J.Sheridan

539.19

20692 DIPOLE MOMENTS AND RELAXATION TIMES OF SOME SIMPLE KETONES.

A.Vyas and H.N.Srivastava.

J. sci. industr. Res., Vol. 18B, No. 10, 399-401 (Oct., 1959).

Dipole moments and relaxation times of some simple ketones were determined using a modified Debye equation. The relaxation time was found to increase for every CH_2 group added to one or both the alkyl groups on either side of the $C = O$ group. It was also observed that the effect of addition of one hydrocarbon group to both the alkyl groups is the same as that of adding two such groups to only one of the alkyl groups. The dependence of relaxation time on chain length was also investigated.

539.19

20693 EQUILIBRIUM BOND LENGTHS IN METHANE AND DEUTEROMETHANE AS DETERMINED BY ELECTRON DIFFRACTION AND SPECTROSCOPIC METHODS.

L.S.Bartell, K.Kuchitsu and R.J.DeNeui.

J. chem. Phys., Vol. 33, No. 4, 1254-5 (Oct., 1960).

New electron diffraction data for CH_4 and CD_4 yield mean bond distances of CH = 1.107_0 A and CD = 1.102_3 A. Standard errors are thought to be not much over 0.001 A. This is the first demonstration of an isotope effect on distances by means of electron diffraction. The mean distances exceed, by about 0.01 A, the r_0 values determined spectroscopically, but, when corrections are applied, the results from the two techniques yield the same value, 1.085 A, for the equilibrium bond-distance for CH and CD. J.Sheridan

539.19

20694 CORRELATION OF BOND SHORTENING BY ELECTRONEGATIVE SUBSTITUENTS WITH ORBITAL HYBRIDIZATION.

H.A.Bent.

J. chem. Phys., Vol. 33, No. 4, 1259-60 (Oct., 1960).

A correlation based on changes in hybridization of bonding electron orbitals is proposed to account for shortenings of the bond XA in X—A—Y when Y is replaced by an atom of greater electronegativity than Y. The replacement is regarded as directing s-character in the valency-shell of A towards the XA bond. The s-character is thus concentrated in bonds to more electropositive groups, with resultant shortening of these bonds. Many references are given to earlier work incorporating similar ideas.

J.Sheridan

539.19

20695 BOND SHORTENING BY ELECTRONEGATIVE SUBSTITUENTS.

H.A.Bent.

J. chem. Phys., Vol. 33, No. 4, 1260-1 (Oct., 1960).

Some recent data are assembled to emphasize that bond shortenings of the type referred to in the preceding abstract are of wide occurrence. It is pointed out that approaches based on certain types of structural generalizations would not predict shortenings. J.Sheridan

539.19

20696 A THERMODYNAMIC DISCRIMINANT FOR THE LENNARD-JONES POTENTIAL.

W.B.Brown and J.S.Rowlinson.

Molecular Phys., Vol. 3, No. 1, 35-47 (Jan., 1960).

It is shown that for an assembly of molecules interacting with the Lennard-Jones n : 6 pair potential the classical fluctuation discriminant Δ of the configurational energy U and the virial V, defined by

$$\Delta = [\overline{\delta U^2}\,\overline{\delta V^2} - (\overline{\delta U \delta V})^2]/(kT)^2.$$

can be related exactly to configurational thermodynamic propertie and the repulsion exponent n. The condition that the discriminant essentially positive (Schwarz's inequality) provides an experiment lower bound for n. The experimental behaviour of the discrimina for argon is examined for solid, liquid and gas states. It is found that the assumption of a 12 : 6 potential leads to negative values o Δ over certain temperature and pressure ranges of the fluid. It appears that a value of n between 13 and 14 would be sufficient to satisfy the inequality for the liquid, but that a much higher value i indicated by the less reliable results for the gas at high temperatures. The theoretical behaviour of the discriminant is discussed and it is shown that Δ should tend to zero rapidly at high tempera tures and at high densities. A brief account is given of the appropriate quantal analogue of Δ which unfortunately appears to be experimentally inaccessible.

539.19 : 530.

STUDIES IN MOLECULAR DYNAMICS. See Abstr. 18993

539.19 : 533.

COLLISION TRAJECTORIES FOR INVERSE POWER INTERMOLECULAR POTENTIALS. See Abstr. 19193

539.1

20697 STATISTICS OF ISOTACTIC DEFORMABLE CHAINS WITH INTERDEPENDENT INTERNAL ROTATIONS.

V.Magnasco and C.Rossi.

J. chem. Phys., Vol. 32, No. 6, 1881-2 (June, 1960).

A theory of mean dimensions of vinylic isotactic macromolecu is developed by the method of matrices of rotation. A general expression for the mean square end-to-end distance is given from which all the results given in the literature may be derived. For statistically independent rotations the formula reduces to that of Nagai (Abstr. 7482 of 1959). R.G.C.Arrid

539.1

20698 NORMAL VIBRATIONS OF THE POLYMER MOLECULES OF HELICAL CONFIGURATION.

H.Tadokoro.

J. chem. Phys., Vol. 33, No. 5, 1558-67 (Nov., 1960).

A method suitable for numerical calculations of the normal vibrations of helical molecules is derived by the use of GF-matrix method. The method is described for the case of the isolated infinite helical molecule in which the one-dimensional crystallographi repeat unit contains n chemical units and m turns (one chemical unit contains p atoms). It is shown that the optically active fundamental frequencies of such molecules can be obtained by solving the secular equations for A, B, E_1, and E_2 species, the maximum orders of which are 3p-2, 3p, 3p-1, and 3p, respectively. This method can be also applied to the cases of infinitely extended planar zigzag chains such as polyethylene and cyclic molecules such as trioxane, etc., as special cases. As examples of application of this method, calculations of the skeletal vibrations of a simple model of polyoxymethylene molecule under the group $D(10\pi/9)$ and of the planar zigzag chain of carbon atoms are given.

539.

20699 A SEMI-EMPIRICAL THEORY OF THE CONJUGATED SYSTEMS. III. BOND ALTERNATION AND ELECTRO FIXATION.

Y.Ooshika.

J. Phys. Soc. Japan, Vol. 14, No. 6, 747-9 (June, 1959).

Extending the treatment of Pt II (Abstr. 8743 of 1959) on the bond alternation in infinite conjugated systems to finite systems, it is investigated why the wavelengths of some homologous series appear to tend to infinity while those of others to finite limits whe the number of carbon atoms increases. It is concluded that the bo alternation does not occur in shorter symmetrical or slightly unsy metrical chains, while, in strongly unsymmetrical chains, the bon alternation always occurs and that it always occurs in longer chai according to the result in Pt II.

539.

20700 WAVE FUNCTIONS AND ENERGY EIGENVALUES FO THE POLYTETRAFLUOROETHYLENE CHAIN.

Yoh-Han Pao and R.F.Bjorklund.

J. appl. Phys., Vol. 31, No. 11, 1925-34 (Nov., 1960).

A quantum mechanical investigation is presented of an isolate polytetrafluoroethylene molecule. The purpose of this investigation is twofold: to find the energy gap between filled and empty electronic bands and to determine the energy required to change the conformation of the molecule. For reasons of simplicity, the on atoms are assumed to have the planar zigzag conformation e ground state of the molecule. Molecular wave-functions are structed from Bloch sums taken along the four rows of fluorine ns. The basis functions used are Gaussian approximations to nd 3s atomic orbitals. The suitability of this choice is tested preliminary calculation of the dissociation energy of the hydro- fluoride molecule. In polytetrafluoroethylene, the molecular itals form bands. The energy gap between the filled 2p band and empty 3s band is calculated as 10.07 eV, suggesting negligible insic semiconduction. The width of the 2p band is 0.0625 eV, ifying that chain conformation may change easily at room tempe- ure, for example from a right-handed helical conformation to the formation of the opposite hand.

539.19

20701 ON THE VISCOSITY OF IRRADIATED POLYMERS. II.

M.Inokuti and K.Katsuura.

J. Phys. Soc. Japan, Vol. 14, No. 10, 1379-87 (Oct., 1959).

For Pt I, see Abstr. 11541 of 1959. The intrinsic viscosity of lymeric substance crosslinked as well as degraded by irradiation high-energy radiations is discussed for various types of initial ecular size distributions. The intrinsic viscosity as a function adiation dose is shown to behave in a great variety of ways depend- on the relative importance of crosslinking and degradation, and in ticular, on the shape of the initial distribution. The effect of end- king instead of crosslinking is also examined.

539.19

20702 DETERMINATION OF MOLECULAR WEIGHT DISTRIBUTIONS OF HIGH POLYMERS BY FRACTIONATION.

kamoto.

Phys. Soc. Japan, Vol. 14, No. 10, 1388-96 (Oct., 1959).

There are several questionable assumptions in the determination molecular weight distributions of high polymers by fractionation. e reliability of the molecular weight distribution is therefore very blematical. The theoretical basis of two fractionation methods is nsidered: one is Spencer's method and the other is the successive ecipitation method (SPM). Solving simultaneous integral equations, nodified Spencer's method is proposed. Though it necessitates asuring the ratio of the volume of the solution phase to that of the ecipitated phase, the results are more accurate than Spencer's thod. A modified SPM is also proposed. The results are also com- red with a numerical calculation made by other authors and found be in accord with them.

539.19

20703 THE POSSIBILITY OF ANOMALOUS MAGNETIC PROPERTIES IN MACROMOLECULES.

L.Ginzburg and V.M.Fain.

kl. Akad. Nauk SSSR, Vol. 131, No. 4, 785-8 (April 1, 1960). Russian.

Attempts a theoretical explanation of strong electron spin sonance lines and of anomalous magnetic properties in a number polymers (L.A.Blyumenfel'd, L.E.Kalmanson and Shen Pei-gen', okl. Akad. Nauk SSSR, Vol. 124, No. 5, 1144, Feb. 11, 1959; A.Blyumenfel'd, Biofizika, Vol. 4, 515, 1959; A.A.Berlin, A.Blyumenfel'd et al., Výsomolekulyarnȳe soedineniya, Vol. 1, 61, 1959). F.Lachman

539.19

20704 OPTICAL AND OTHER ELECTRONIC PROPERTIES OF POLYMERS.

I.Tinoco,Jr.

chem. Phys., Vol. 33, No. 5, 1332-8 (Nov., 1960).

The properties of a polymer are related to the properties of its onstituent groups and to its geometry. That is, relations between olymer wave-functions and group wave-functions are obtained. he equations generalize a result of Kirkwood to include the effect f time-average fields. The main assumption in the derivation is that o exchange of electrons between groups occurs. The usefulness of hese wave-functions is illustrated by expressions for the absorption oefficient, polarizability, optical rotation, dipole moment, and tability of a polymer.

539.19

20705 STRUCTURE AND ORIENTATION OF FREE RADICALS FORMED BY IONIZING RADIATIONS IN CERTAIN ATIVE PROTEINS.

W.Gordy and H.Shields.

Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 8, 1124-36 (Aug., 1960).

Some native proteins (e.g. silk and feather keratin) have been nvestigated by the method of electron spin resonance while being rradiated by ionizing radiation. The structure and orientation of the resulting free radicals have been deduced in some cases and it has been demonstrated that this method can give information about the structure of the proteins which supplements that obtained from X-ray diffraction and infrared studies. Amongst other results, the present investigation has shown that in irradiated hair and feather quill the resonance characteristic of polycrystalline cystine is observed for all orientations of the axis of the hair fibre or quill in the static magnetic field. It is suggested that this indicates that the C—S or S—S bonds are polyoriented in these substances. J.Iball

539.19

20706 TEMPERATURE EFFECTS ON FREE RADICAL FORMATION AND ELECTRON MIGRATION IN IRRADIATED PROTEINS.

F.Patten and W.Gordy.

Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 8, 1137-44 (Aug., 1960).

The electron spin resonance patterns of glycine and silk, casein and pepsin, acetyl glycine, L-cysteine and toe-nail, DL-cystine and bovine albumin and steer's horn were observed at 77° K and 300° K. Co^{60} γ-irradiation was performed at 77° K. The resonance pattern at 77° K after irradiation is wide and unspecific and consistent with the expected random distribution of electron vacancies and negative charges induced by the irradiation in the protein molecule. On warming to 300° K this pattern changes irreversibly into one recognizably belonging to a free radical at α-C atom of a peptide backbone or at the S atom of cysteine. It is concluded that the vacancies and negative charges are able to migrate in the molecule at 300° K, but are almost immobile at 77° K. An exception is acetyl glycine. The doublet characteristic at room temperature is produced by irradiation at 77° K without warming, suggesting that the unpaired electron of the ionized molecule is in a π orbital. Mechanisms for the formation of the characteristic free radicals seen at room temperature from those observed at 77° K are suggested. M.Ebert

539.19

20707 THEORY OF "MELTING" OF THE HELICAL FORM IN DOUBLE CHAINS OF THE DNA TYPE.

B.H.Zimm.

J. chem. Phys., Vol. 33, No. 5, 1349-56 (Nov., 1960).

Previous theoretical treatments of the transition between the helical and random forms of the desoxy-ribose nucleic acid (DNA) molecule are extended to include formally the explicit consideration of the dissociation into two separate chains and the consideration of the effects of the ends of the chains. An approximate form for the fraction of base pairs that are bonded is obtained in terms of two parameters, a stability constant for base pairing and a constant representing the interaction of adjacent base pairs. The matrix method of statistical mechanics proves to be adaptable to this problem. Some numerical examples are worked out for very long molecules, for which case it is found that the effect of concentration is small.

539.19

20708 ELECTRON INTERACTION IN VERY LONG LINEAR CONJUGATED MOLECULES. II. ELEMENTARY EXCITATIONS IN A SYSTEM WITH SMALL ENERGY GAP.

T.Izuyama.

Progr. theor. Phys., Vol. 22, No. 5, 681-703 (Nov., 1959).

For Pt I, see Abstr. 17859 of 1960. Low-lying excited states in a one-dimensional system which has a small energy gap (ϵ_g) in the spectra of H_0, the one-electron Hamiltonian, are investigated. Plasmons and excitons are the main interest. These states are investigated in the framework of the tight-binding approximation. In usual one-dimensional systems, such as very long linear conjugated molecules, the plasmon levels sink into the level continuum given by excitation energies of one-pair states. However, it is shown that the plasma oscillations are stable when their energies are sufficiently larger than the energy gap. On the other hand, the plasma oscillations with sufficiently small momentum whose energies in case of $\epsilon_g = 0$ were smaller than the present energy gap seem to be dissolved away into the level continuum. A formulation to derive exciton solutions is given. The screening effect for the attractive force between the electron and the hole is investigated by means of the Gell-Mann and Brueckner technique and is found to grow larger as the energy gap becomes smaller. By this screening effect, the possibility of getting the exciton-like bound state diminishes as $\epsilon_g \to 0$. As a collorary it is found that the potential energy of two electric charges z_1e and z_2e separated by a distance r in a three-dimensional system with small energy gap becomes $z_1z_2e^2 \exp(-\alpha r)/r$ if $r \ll |B/\Delta B|$, where $|B|$ is a measure of the Fermi energy and ΔB is a measure of the gap, while it becomes $z_1z_2e^2/\epsilon r$ if $r \gg |B/\Delta B|$, where $\epsilon \propto r_s^{-1}(|B|/(\Delta B)^2) \times (e^2/a_B)$.

539.19 : 530.16

ROTATIONAL BROWNIAN MOVEMENT OF CHAIN MACROMOLECULES. See Abstr. 18995

539.19 : 539.17

20709 ON THE POSSIBILITY OF DIRECTED INJECTION OF DEUTERIUM AND TRITIUM IN A NUCLEAR FUSION EXPERIMENT.

E.W.Becker, R.Klingelhöfer and P.Lohse.

Z. Naturforsch., Vol. 15a, No. 7, 644-5 (July, 1960). In German.

An improved beam producing apparatus is described, in which the beam from a 0.15 mm diameter nozzle is passed through a collimator of 0.9 mm diameter. If the stripped molecules are separately pumped off, the resulting beam is very dense and sharply defined. Numerical values of beam density and profile are given as functions of inlet pressure and distance beyond the collimator. P.Gray

539.19 : 536.55

POSSIBLE APPLICATION OF MOLECULAR BEAM TECHNIQUES TO THE MEASUREMENT OF SURFACE TEMPERATURES. See Abstr. 19521

539.19

20710 QUANTITATIVE RELATIONS IN THE MASS SPECTRA OF n PARAFFINS.

N.D.Coggeshall.

J. chem. Phys., Vol. 33, No. 4, 1247-52 (Oct., 1960)

The mass spectra of n-paraffins in the C_6 to C_{30} range were examined for quantitative relations that must be predicted by any theory of ion formation by electron impact. An ion sum C(M,n) is defined as the sum of the normalized intensities of all ions of n carbon atoms from a n-paraffin of M carbon atoms. The molar yield Y(M,n) per unit of ionizing current will be MC(M,n). It was observed that for large ions from large molecules the yield is independent of M or n but proportional to (M −n). Yields for smaller ions, i.e., n between 3 and 15, are linear with M but not proportional to M. The yields in this region may be expressed as

$$Y(M,n) = An^4e^{-bn}(M-n')$$

where A and b are constants, one set applying for $3 \leq n \leq 10$ and a other set applying for $10 \leq n$; the n' values are constants, each depending upon the associated n. The observations indicate that th details of the fragmentation process for n-paraffins depend primari upon the type of molecular skeleton, i.e., straight chain, single valence carbon—carbon linkages and secondarily upon the size of the molecule.

539.19

20711 TEMPERATURE DEPENDENCE OF THE MASS SPECTRA OF HYDROCARBON MOLECULES AND ITS SIGNIFICANCE FOR THE STATISTICAL THEORY.

H.Ehrhardt and O.Osberghaus.

Z. Naturforsch., Vol. 15a, No. 7, 575-84 (July, 1960). In German.

The "cracking" of hydrocarbon molecules by the bombarding electrons limits the usefulness of mass spectrometry as an analytical tool for hydrocarbon mixtures. The discrepancy between the calculated and measured spectra of propane as a function of the temperature is possibly caused by a lack of knowledge with regard to the excitation energies taken up by the molecules during electro bombardment. R.Schnurmann

539.1

20712 PARTITION FUNCTION RATIOS FOR MOLECULES CONTAINING NITROGEN ISOTOPES.

G.M.Begun and W.H.Fletcher.

J. chem. Phys., Vol. 33, No. 4, 1083-5 (Oct., 1960).

Nitrogen isotopic partition function ratios are calculated for th following molecules and ions: N_2, N_2O, NO, NOCl, NO_2, NO_2^-, NO_3^- and N_2O_4. All available isotopic and anharmonic data are used, and values of Q^{15}/Q^{14} are tabulated for temperatures at intervals from 100°K to 600°K. Isotopic equilibrium constants calculated from the partition function ratios are compared with those that have been ob served experimentally.

SOLID-STATE PHYSICS

539.2

20713 MIDWEST SOLID-STATE PHYSICS CONFERENCE.

D.W.Lynch.

Phys. Today, Vol. 13, No. 4, 40-2 (April, 1960).

Report of a conference held on 10 Oct. 1959 at Iowa State University. 18 papers were presented covering a wide range of subjects. The invited address was by Van Vleck and was a review of the successes of crystalline field theory in interpreting the magnetic properties of paramagnetic ions in crystals.

539.2

20714 DIAMOND PHYSICS.

F.C.Champion.

Nature (London), Vol. 188, 368-9 (Oct. 29, 1960).

Report of a conference held on 22-23 Sept., 1960 at the University of Reading under the the auspices of the Institute of Physics and the Physical Society. Twenty-one papers were presented. Apart from two theoretical papers on electron density and bond orbitals the remainder were experimental. These covered a wide field including synthetic diamonds; semiconducting diamonds, graphitization, irradiation damage, and mechanical properties.

539.2

20715 SILICON CARBIDE.

J.R.O'Connor.

Phys. Today, Vol. 12, No. 11, 14-17 (Nov., 1959).

Report of an international conference held at Boston, Mass. on 2 and 3 April, 1959. There were five sessions under the following headings: 1) The Silicon—Carbon Binary System. 2) The Growth of Silicon Carbide Single Crystals. 3) Silicon Carbide as a Solid. 4) Silicon Carbide as a Semiconductor. 5) Silicon Carbide Devices.

539.2

20716 EQUATION OF STATE OF CLASSICAL ELECTRON GAS.

R.Abe.

Progr. theor. Phys., Vol. 21, No. 3, 475-6 (March, 1959).

Reports briefly a cluster expansion calculation showing that the Debye—Hückel law is exact to the first order in λ, the non-dimensional parameter characteristic of the classical electron gas. This contradicts Ichikawa's result obtained by another metho (Abstr. 15019 of 1960). D.M.Edwar

539.2 : 536.7 : 53

EQUATION OF STATE OF SODIUM CHLORIDE AT HIGH PRESSURES. See Abstr. 20730

53

20717 BRILLOUIN ZONES AND CRYSTAL STRUCTURE FACTORS.

T.H.K.Barron and G.Fischer.

Phil. Mag. (Eighth Ser.), Vol. 4, 826-9 (July, 1959).

Brillouin zones in reciprocal space are most logically defined by Brillouin's original method, solely in terms of the Full Bravais Lattice giving the full translational symmetry of the crystal. Another method, which rejects zone boundaries of vanishing structure-factor, is illogical, both because it is possible to have a energy discontinuity of electron states across a plane of zero structure-factor, and because it ignores the energy continuity within Brillouin's original zones. The energy is always continuous within the true Brillouin zones, which must contain two electron states for each unit cell of the Full Bravais Lattice.

53

20718 EFFECT OF CHEMICAL TREATMENT ON THE STRUCTURE AND PROPERTIES OF GRAPHITE.

S.Ray.

Indian J. Phys., Vol. 33, No. 6, 282-3 (June, 1959).

It is suggested that the usual purificatory treatments of graph crystals might lead to important structural changes and the author has looked for and detected such changes by means of X-rays. R.Bullou

539.2

)719 STUDY OF THE SURFACE STATES OF DIAMOND AND GRAPHITE BY A SIMPLE MO-LCAO METHOD.

utecký and M.Tomášek.
. Rev., Vol. 120, No. 4, 1212-18 (Nov. 15, 1960).

The surface states of diamond and two-dimensional graphite
investigated on the assumption that the delimitation of the
tal causes no perturbation within the elementary cells of the
e crystal. In both cases a plane perpendicular to the bond
een a selected pair of carbon atoms is taken as the delimiting
e. The molecular orbitals are assumed in the form of a linear
bination of sp^3 or sp^2 hybrids. In the case of graphite, mole-
r orbitals that are linear combinations of $2p_Z$ orbitals, whose
raction with sp^2 hybrids is neglected, are further considered.
pears that in the case of diamond there exists a band of
gies pertaining to Shockley surface states in the gap between
valence and conductivity bands. The number of atoms in this
l equals the number of atoms in the surface. From a discussion
ie pertinent wave-functions, it follows that these states are an
ession of unsaturated bonds of the surface carbon atoms. The
tron density on the hybrids projecting from the surface is
entially greater than the density on the other hybrids of
surface atoms. Further bands of surface states exist in
region of energies allowed for the volume valence and the
luctivity states. In graphite, a quite analogous behaviour
hown by those surface states whose wave-functions are linear
binations of sp^2 orbitals. Surface states whose wave-functions
linear combinations of p_Z orbitals are a manifestation of unsatu-
ed double bonds of surface atoms having only two neighbours.
analogy between these Shockley states and the nonbonding
es of odd alternant aromatic hydrocarbons is pointed out.

539.2

0720 CALCULATION OF THE CRYSTALLINE FIELD STRENGTH: CHROME ALUM.

Freeman and R.E.Watson.
s. Rev., Vol. 120, No. 4, 1254-60 (Nov. 15, 1960).

A calculation of the crystalline field strength, Dq, is reported
the case of chrome alum, using the same model and crystal
d potential employed by Kleiner (Abstr. 969 of 1953) and re-
tly determined Hartree—Fock wave-functions for the Cr^{+3} ion.
this basis, earlier theoretical attempts at determining, within
framework of crystal field theory, accurate Dq values are
iewed and analysed. Particular emphasis is placed on a consi-
ation of reported point charge calculations and Phillips' method
ncluding the effects of orthogonalization of ligand to metal ion
e functions. The results indicate that the point charge model
mates for Dq gave good results mostly because they were based
he use of improper 3d wave functions for the transition metal
on. Kleiner's result is significantly improved - his wrong sign
Dq is reversed and a small positive Dq is obtained - but in such
ay as to contradict Phillips conclusions. A discussion is given
he various evidence for the inadequacy of the electrostatic po-
ial theory and some of the necessary modifications are indicated.

539.2 : 548.7

20721 DETERMINATION OF INTERATOMIC SEPARATION IN SOLIDS SUBJECTED TO PRESSURE. I. COMPRESS-LITY OF BARIUM AND STRONTIUM.

V.Evdokimova and L.F.Vereshchagin.
z. tverdogo Tela, Vol. 2, No. 8, 1701-7 (Aug., 1960). In Russian.

Describes a simple technique for measurement of compress-
lity of solids at pressures up to 15 000 kg/cm^2, using X-ray
fraction techniques. The compressibility of strontium and barium
s measured, with an accuracy of 3%, up to 20 000 kg/cm^2. The
sults are in fair agreement with those obtained by Bridgman (1923).

A.Tybulewicz

539.2

20722 THE COHESIVE ENERGY OF METALLIC SILVER.

C.Moţoc.
ud. Cercetari Fiz., Vol. 9, No. 3, 379-87 (1958). In Roumanian.

The Wigner—Seitz method was applied to the calculation of the
hesive energy of metallic silver. The crystal potential is taken
om the universal potential determined by Gaspar for noble metals,
y using the statistical method. The Fermi energy has been calcu-
ted by the method of Silverman-Kohn. The cohesive energy was
und to be 19.5 k. cal/mole, when the ionization potential of the s
lectrons has the experimental value, and 59.5 k. cal/mole, when
e ionization potential, determined by Gaspar with the same universal potential was used. In order to determine the correlation energy, the Wigner expression was used. The experimental value of the cohesive energy of silver is 68 k. cal/mole. The discrepancy between the theoretical value and the experimental one is mainly due to the fact that the universal potential determined by Gaspar takes no account of the correlation interaction between the valence and core electrons. In consequence, the value of the ionization potential for the s functions and the electron's energy at the bottom of the Brillouin zone is not very accurately determined.

539.2

20723 THE ESCAPE OF HYDROGEN FROM IRON.

H.B.Wahlin and D.J.Mack.
Acta metallurgica, Vol. 7, No. 10, 687-9 (Oct., 1959).

Hydrogen was introduced into iron rods by electrolysis, producing temporary embrittlement. The brittleness was measured by torsional testing. The brittleness disappears on standing; measurements of the recovery time at temperatures from 60°C to 160°C give an activation energy of 11.6 kcal/mole. It is thought that this represents the dissociation energy of H_2 molecules in the metal into atoms or protons, and that these move freely through the metal and thus let the hydrogen escape.

H.Mykura

539.2

20724 THE EFFECTIVE IONIC CHARGE IN CdS.

F.Keffer.
J. chem. Phys., Vol. 33, No. 4, 1267-8 (Oct., 1960).

Various data on the elastic and piezoelectric constants of CdS are analysed and the ionic charge is found to be either 0.75 e or 0.91 e, the uncertainty arising from the sign of the piezoelectric constants. Recent data on elastic constants gives a value of 0.73 e.

C.A.Hogarth

539.2 : 536.42

20725 A DETERMINATION OF THE MELTING POINT OF ELEMENT 43 (TECHNETIUM).

E.Anderson, R.A.Buckley, A.Hellawell and W.Hume-Rothery.
Nature (London), Vol. 188, 48-9 (Oct. 1, 1960).

The melting point of 0.11 g of Tc was determined to be 2200 ± 50° C. A W-tube resistor furnace was used, the temperature being measured by an optical pyrometer sighted through a small hole in the crucible. Like the melting point of Mn, that of Tc is lower than that of either of the adjacent metals in the same series.

J.Thewlis

539.2

20726 EXTENSION OF THE THEORY OF THE EFFECTS OF ANISOTROPIC RELAXATION TIMES ON THE HALL COEFFICIENTS OF SOME DILUTE ALLOYS OF SILVER.

J.R.A.Cooper and S.Raimes.
Phil. Mag. (Eighth Ser.), Vol. 4, 1149-54 (Oct., 1959).

Previous work (Abstr. 15895 of 1960) is extended to permit the impurity relaxation time, as well as the thermal relaxation time, to be anisotropic. Also the sixth-order cubic harmonic is included in all the expansions, which had previously stopped at the fourth-order harmonic. It is found that agreement with experiment may be improved or, alternatively, the same agreement as before may be obtained with more reasonable values of the empirically determined parameters, provided the thermal and impurity relaxation times can have opposite anisotropies, that is, if the minima of the one occur in the directions of the maxima of the other. It is also possible to explain the experimental results for the silver—gold system, which were at variance with the previous theory. The effects of the inclusion of the sixth-order harmonic are found to be slight, and, in particular, the distance of closest approach of the Fermi surface to the Brillouin zone boundary in pure silver is very little changed.

539.2

20727 A GENERAL DISCUSSION ON IONS OF THE TRANSITION ELEMENTS. GENERAL INTRODUCTION.

J.W.Linnett.
Disc. Faraday Soc., No. 26, 7-20 (1958).

The discussion was held at University College, National University of Ireland, Dublin, on Sept. 9-11, 1958. Dr.Linnett defined as the object of the meeting the consideration of the properties and electronic structures of transition-element ions, especially when they are included in complexes. Three procedures were discussed for treating the electronic structures: (a) the Pauling valence bond method; (b) the molecular orbital method; (c) the ligand (or crystal) field method. The second part of the introduction dealt in general terms with experimental methods for studying the structure of transitional metal ions and their complexes: (a) stereochemistry; (b) i.r. and Raman spectra; (c) thermodynamic properties; (d) visible and u.v. spectra; (e) magnetic susceptibility; and (f) paramagnetic resonance spectra. 20 papers were presented at the discussion; abstracts of these will appear in this or subsequent issues of "Physics Abstracts".

539.2

20728 [IONS OF THE TRANSITION ELEMENTS. OPTICAL AND MAGNETIC PROPERTIES. INTRODUCTORY PAPER]. PHYSICAL PROPERTIES OF TRANSITION IONS.

M.H.L.Pryce.
Disc. Faraday Soc., No. 26. 21-6 (1958).

"Ions of the transition elements" Conference paper (see Abstr. 20727 of 1960). The distinguishing feature of transition ions — the incompletely filled topmost shell of orbitals — is discussed in relation to the physical properties. 71 refs.

539.2

20729 CRYSTAL-FIELD STABILIZATION AND SITE DEFORMATION IN CRYSTALS AND COMPLEXES CONTAINING TRANSITION IONS. N.S.Hush.

Disc. Faraday Soc., No. 26, 145-56 (1958).

"Ions of the transition elements" Conference paper (see Abstr. 20727 of 1960). The effect of crystal-field stabilization on interatomic separations in crystals and complex ions is discussed. This is most marked when the metal ion contains a partially-filled d shell, although small effects are also observed for ions containing partially-filled f shells. For crystals with a simple cubic structre [illegible] complex ions, quantitative calculations of contractions of internuclear distances under the influence of an ion or dipole crystal field can be made, and some examples of these are given.

539.2 : 537.3 : 536.7

20730 DYNAMIC COMPRESSIBILITY, EQUATION OF STATE AND ELECTRICAL CONDUCTIVITY OF SODIUM CHLORIDE AT HIGH PRESSURES.

L.V.Al'tshuler, L.V.Kuleshova and M.N.Pavlovskii.
Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 16-24 (July, 1960). In Russian.

Results of an experimental investigation of shock compressed single crystals are presented for pressures ranging from 5×10^4 to 8×10^5 atm. On the basis of these data, the equation of state for sodium chloride in the high pressure region is deduced. It is shown that in the investigated compression region, the ion interaction potential can be satisfactorily described by a formula with an exponential term for the repulsion forces. The method for the measurement of the electrical conductivity is described. The dependence of the electrical conductivity on temperature under shock compression conditions is obtained and the activation energy is estimated. It is demonstrated that a sharp increase of the conductivity takes place behind the shock-wave front. As under normal conditions, the conductivity is of an ionic nature.

539.2

20731 SOFT X-RAY EMISSION SPECTRA FROM LITHIUM AND LITHIUM—MAGNESIUM ALLOYS.

J.A.Catterall and J.Trotter.
Phil. Mag. (Eighth Ser.), Vol. 4, 1164-70 (Oct., 1959).

An examination of the emission spectra from lithium and lithium—magnesium alloys indicated that in the alloys electron transfer takes place from magnesium to lithium. The shape of the high-energy edge of the lithium K emission spectrum could be explained by broadening of the 1s ionic level in the crystal.

539.2

20732 THE K EMISSION SPECTRUM OF METALLIC LITHIUM. R.S.Crisp and S.E.Williams.

Phil. Mag. (Eighth Ser.), Vol. 5, 525-7 (May, 1960).

Reports spectral intensity measurements of the K emission of lithium in the third order in an improved spectrometer in which target heating and contamination were substantially absent. The spectrum clearly shows a high-energy edge of width 0.3 eV. Spectral distributions obtained by previous authors are briefly discussed.

A.E.I. Research Laboratory

539.2 : 535.33

20733 THE K ABSORPTION SPECTRUM OF GALLIUM. W.M.Weber and H.Brinkman.

Physica, Vol. 25, No. 7, 633-9 (July, 1959).

The fine structure near the K absorption edge of metallic gallium has been investigated at 17 and −185°C, accurately measuring the intensities transmitted by a 23 micron gallium foil between 1200 and 1145 X.U. by the photographic method. The observed fi structure within 400 eV from the edge differs considerably from that found by Mutch (1936). A comparison is made with the fine structure computed by Smoluchowski (1936).

539.2 : 535.

20734 INVESTIGATION OF THE MAIN X-RAY K-ABSORPT EDGE IN SELENIUM. D.Balli and L.Myuller.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1381-2 (1960). In Russian.

The position and width of the main X-ray K-absorption edge were measured for crystalline and amorphous selenium. Dependence of the structure of the main edge on thickness of the absorb was investigated.

53

20735 THE X-RAY NON-DIAGRAM LINES Kβ' OF SOME COMPOUNDS OF THE IRON GROUP. K.Tsutsumi.

J. Phys. Soc. Japan, Vol. 14, No. 12, 1696-1706 (Dec., 1959).

The wavelength values and relative intensities of the X-ray n diagram lines $K\alpha_{3,4}$ of metallic iron and $K\beta'$ of Cr_2O_3, $Cr_2(SO_4)_3 \cdot nH_2O$, MnO_2, $MnSO_4 \cdot 4H_2O$, Fe_2O_3 and $Fe(NH_4)_2(SO_4)_2 \cdot 6$ were measured by the fluorescent X-ray method using two differ characteristic X-rays. The $K\alpha_{3,4}$ lines did not appear when an ir atom was excited by Ni K-rays but were clearly observed when excited by Cu K-rays. This was expected from the origin of the $K\alpha_{3,4}$ lines that is supposed to arise from a KL—LL transition. In the case of the $K\beta'$ line no difference was found regardless of whether it was excited by photons of energy lower or higher than $K(Z) + L(Z+1)$ which is necessary to remove simultaneously a and an L electron of an atom (Z). Therefore, the author may co clude that the $K\beta'$ line is due not to the double but to the single ionization process and that it can be derived from the difference the exchange interactions of the states having different total spin $(S+\frac{1}{2})$ and $(S-\frac{1}{2})$, where S is the total spin of the incomplete 3d shell and $\frac{1}{2}$ is that of the incomplete 3p shell in the final state. T energy separations of the $K\beta_1$ and $K\beta'$ lines calculated from the above-mentioned exchange energies nearly agree with those obse in the experiments.

539.2 : 535

20736 COMPARATIVE INVESTIGATION OF THE FINE STRUCTURE OF THE X-RAY EMISSION LINES OF T Kβ-GROUP OF TITANIUM IN THE METAL FORM AND IN COMPOUNDS WITH SEVERAL LIGHT ELEMENTS.

E.A.Zhurakovskii and É.E.Vainshtein.
Dokl. Akad. Nauk SSSR, Vol. 129, No. 6, 1269-72 (Dec. 21, 1959). In Russian.

In previous papers (see for example E.E.Vainshtein and E.E.Zhurakovskii, Abstr. 5889 of 1960) the authors reported meas urements of the $K\beta$-group spectra of titanium in the oxide, carbid nitride and hydride form. This paper reports the extension of thi work, using as before a high-resolution quartz spectrometer, to t boride, silicide and beryllide form. Eight new spectral determin tions of the $K\beta_5$ line and $K\beta''$ satellite are presented graphically a the significance of these latest results is briefly discussed.

T.Mul

Lattice Dynamics

53

20737 A STUDY OF THE LATTICE VIBRATIONS OF TELLURIUM BY THE METHODS OF GROUP THEOR

Yu.L.Rabotnikov.
Fiz. tverdogo Tela, Vol. 2, No. 9, 2095-108 (Sept., 1960). In Russian.

The relations obtained between the frequencies and the interatomic force constants are given in an appendix. It is shown that for Te and Si the secular equation is considerably simplified for certain lines of the Brillouin zone, and the degeneracy resulting from crystal symmetry is demonstrated.

R.Ber

53

20738 THE FOUNDATIONS OF THE THEORY OF INCOMPLETELY POLAR CRYSTALS. K.B.Tolpygo.

Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 2, 192-201, Disc. 212-13 (1960). In Russian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 1960). An earlier discussion [Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 21, 48(1957)] is extended to evaluate the potential energy of a

tal and to find the vibrational energy levels. It is shown that ı external field the charges of all ions change, leading to an a dipole moment of the crystal, produced both directly by the and by the secondary process of the change of charge with lacement of the nuclei.
R.Berman

539.2

0739 NEW SOLUTION OF THE ISING PROBLEM FOR A RECTANGULAR LATTICE. C.A.Hurst and H.S.Green.

hem. Phys., Vol. 33, No. 4, 1059-62 (Oct., 1960).

A new solution of the Ising problem for a rectangular lattice is ved from first principles. The solution, which is obtained braically, can be presented in a determinantal form different n though related to that found by Kac and Ward. By connecting algebraic approach with the combinatorial solution, the latter is d from dependence on topological conjectures. The new solution onsidered to be fundamentally simpler than the others.

539.2

0740 LATTICE DYNAMICS OF ALKALI HALIDES. W.Cochran.

l. Mag. (Eighth. Ser.), Vol. 4, 1082-6 (Sept., 1959).

Results are given for a calculation of the dielectric properties ome alkali halides with the NaCl structure. The method used is evelopment of the "distortion polarization" approach introduced Szigeti (Abstr. 3212 of 1949; 2104 of 1951). Good agreement with eriment is claimed.
J.W.Leech

539.2 : 539.18

20741 ERRATUM: LATTICE ENERGIES OF THE ALKALI HALIDES AND THE ELECTRON AFFINITIES OF THE LOGENS. D.Cubicciotti.

hem. Phys., Vol. 33, No. 5, 1579 (Nov., 1960).

See Abstr. 2783 of 1960.

539.2

20742 LATTICE VIBRATIONAL SPECTRUM OF SODIUM CHLORIDE. J.R.Hardy.

l. Mag. (Eighth Ser.), Vol. 4, 1278-81 (Nov., 1959).

The results of two frequency spectra calculations for NaCl are sented. The first method allows only for polarization due to ion placement, the second takes into account the distortion polariza- effect as introduced by Szigeti (Abstr. 2104 of 1951).
J.W.Leech

539.2

20743 LATTICE VIBRATIONS OF SODIUM CHLORIDE: EXPERIMENTAL AND THEORETICAL HEAT CAPACITY TA. J.R.Hardy and A.M.Karo.

l. Mag. (Eighth Ser.), Vol. 5, 859-66 (Aug., 1960).

Vibrational frequency spectra derived from two theoretical dels which allow for ionic deformability, instead of treating the s as rigid point charges, are used to calculate "effective" Debye peratures and distribution function moments. The results are npared with those deduced from specific heat measurements. the second, more refined, model the agreement with experiment considerably better than that achieved when the ions are treated as id point charges as in the simple Born theory.

539.2

20744 ON THE INVERSION OF THE SPECIFIC-HEAT FUNCTION. G.Weiss.

ogr. theor. Phys., Vol. 22, No. 4, 526-30 (Oct., 1959).

A method is presented for the inversion of specific heat data to d the vibrational frequency spectrum of a solid. Results are ven in terms of a power series in ω, the frequency. In this series e coefficients depend on $C_V(T)$ and its derivatives at $T = 0$. The ries thus derived is valid only in an asymptotic sense, but repre- nts an improvement over inversions by Montroll (Abstr. 2078 of 42) and Kroll (Abstr. 8772 of 1953) which require a knowledge of nctions formed from the data, and the evaluation of double inte- als over these functions. A method for forming the successive lues of $C_V^{(n)}(0)$ from experimental data is also presented.

539.2

20745 THE THERMAL PROPERTIES OF ALKALI HALIDE CRYSTALS. III. THE INVERSION OF THE HEAT APACITY. T.H.K.Barron and J.A.Morrison.

oc. Roy. Soc. A, Vol. 256, 427-39 (July 5, 1960).

For Pt II see Abstr. 163 of 1960. This paper discusses further e information that can be obtained about lattice harmonic frequency spectra from the experimental heat capacities reported in Pt I. A detailed study is made of sodium chloride, for which spectra of different analytic forms are fitted to the heat capacity within experimental error (0.2%), thus showing how closely the spectrum is determined by the heat capacity. The information obtained agrees with general features of the theoretical spectra of Kellerman, Karo and Hardy; but more important are the following general conclusions drawn from this example. The low-frequency expansions $(\alpha\nu^2 + \beta\nu^4 + \ldots)$ and moments μ_n derived in Pt II do not comprise all the information obtainable from the heat capacity, but suffice to determine a rough integral spectrum. This integral spectrum is determined a little more closely by the heat capacity itself, and the approximate shape of the differential spectrum can be determined not only at low but also at intermediate frequencies $(h\nu < \frac{1}{2}k\Theta_\infty)$, provided that it is known from theory that at low frequencies the spectrum has the form $\alpha\nu^2 + \beta\nu^4 + \ldots$; if this expansion cannot be assumed, however, nothing can be deduced about the detailed spectral shape in any frequency range. Greater experimental accuracy would determine the spectrum more closely at low and intermediate frequencies, but (partly because of anharmonic effects) is still not likely to give much information at high frequencies. Further information must therefore be obtained from other types of experiment or from theoretical models. Particularly accurate information is seen to be contained in the negative moments, which are therefore tabulated for the five salts discussed in this series of papers: sodium chloride and iodide, and potassium chloride, bromide and iodide.

539.2 : 536.63

20746 THE SPECIFIC HEAT OF ANNEALED AND COLD-WORKED COPPER FROM 0.4° TO 1.5°K. D.L.Martin.

Canad. J. Phys., Vol. 38, No. 10, 1390-1 (Oct., 1960).

The measurements were made in a He^3 cryostat using a superconducting heat switch, and the copper samples were those used previously by the author (Abstr. 2786 of 1960). The results, shown graphically, indicate that the lattice component of the specific heat varies from about 15% of the total at 1.5°K to about 2% at 0.5°K. It is inferred that the dislocation density is not greater than 10^{11} dislocations cm^{-2}.
S.Weintroub

539.2

20747 TEMPERATURE DEPENDENCE OF THE DEBYE TEMPERATURES OF ALUMINIUM, LEAD, AND BETA BRASS BY AN X-RAY METHOD. D.R.Chipman.

J. appl. Phys., Vol. 31, No. 11, 2012-15 (Nov., 1960).

The temperature dependence of the Debye temperature of aluminium, lead, and beta brass was determined by measuring the integrated intensity of a high angle X-ray diffraction peak from each of the materials as a function of temperature. This measured temperature dependence agrees with the corresponding function obtained from elastic constant data, although it is determined by much higher lattice frequencies. In agreement with the elastic constant measurements, evidence is found for an explicit temperature dependence beyond that resulting from the simple dependence of Debye temperature on volume.

539.2

20748 SURFACE SPECIFIC HEAT OF AN ISOTROPIC SOLID AT LOW TEMPERATURES.

M.Dupuis, R.Mazo and L.Onsager.

J. chem. Phys., Vol. 33, No. 5, 1452-61 (Nov., 1960).

The effect of realistic boundary conditions on the computation of the specific heat of an isotropic solid at low temperatures is investigated. Two cases are considered: the surface free of stress and the surface rigidly clamped. The first of these is the one of physical interest. For both cases a term in the specific heat arises which is proportional to the surface area and to T^2 and appreciably higher than Montroll's result in the case of the free solid. The effect of approximations introduced during the computation is estimated. Available experimental data are not adequate for a critical test of the theory.

539.2

20749 THE LATTICE SPECIFIC HEATS OF SOLID HYDROGEN AND DEUTERIUM.

R.W.Hill and O.V.Lounasmaa.

Phil. Mag (Eighth Ser.), Vol. 4, 785-95 (July, 1959).

Measurements of the specific heats of solid parahydrogen and orthodeuterium in the temperature range from 2 to 18°K are described. Anomalous contributions arising from orthohydrogen and paradeuterium impurities were minimized by converting the specimens catalytically in the liquid state, but could only be made negligible for hydrogen. The specific heat at constant volume is deduced for each substance, and its temperature variation discussed in terms of a reduced Debye temperature. It is shown that the behaviour of both substances is very similar to that calculated by Leighton (1948) for crystals of f.c.c. structure.

539.2 : 536.48

DIFFERENCE IN LATTICE SPECIFIC HEATS IN THE NORMAL AND SUPERCONDUCTING PHASES. See Abstr. 19565

539.2

20750 THE SPECIFIC HEAT OF CERIUM MAGNESIUM NITRATE BELOW 10°K. C.A.Bailey.

Phil. Mag (Eighth Ser.), Vol. 4, 833-5 (July, 1959).

The specific heat was measured in the range 1.5° to 10°K where the magnetic specific heat is negligible compared with the lattice specific heat. It was found that above 3°K the lattice specific heat cannot be represented by a single Debye term but below this temperature it is given by $C_L = 1.13 \times 10^{-3}\ RT^3$.

539.2

20751 SPECIFIC HEAT AND THERMAL EXPANSION OF FLUORSPAR. S.Ganesan and R.Srinivasan.

Proc. Nat. Inst. Sci. India A, Vol. 25, No. 2, 139-53 (March, 1959).

These properties were calculated from an approximate vibration spectrum derived from a model of this crystal employed in calculating its elastic constants. The theoretically calculated values are in fair agreement with the experimentally observed values. In particular the Grüneisen constants for the frequencies in fluorspar lattice vary by a factor of eight - which explains why Grüneisen's equation for the thermal expansion of fluorspar does not agree with the experimental values over the entire temperature range from 90° - 910°K.

539.2 : 536.63

20752 RESULTS OF INVESTIGATIONS AT LOW TEMPERATURE. XXXII. THE ATOMIC AND ELECTRONIC HEAT OF VANADIUM AND NIOBIUM BETWEEN 10° AND 273°K.

K.Clusius, P.Franzosini and U.Piesbergen.

Z. Naturforsch., Vol. 15a, No. 8, 728-34 (Aug., 1960). In German.

For Pt XXXI, see Abstr. 1562 of 1960. The calculated standard entropies are 6.85 ± 0.05 cal degree^{-1} g-atom^{-1} for V and 8.58 ± 0.05 cal degree^{-1} g-atom^{-1} for Nb. For V, the coefficient γ (in cal degree^{-2} g-atom^{-1}) obtained below 20°K is 16×10^{-4}, whereas 15.5×10^{-4} is found above 100°K. The corresponding Debye temperatures Θ are 425° and 419°, respectively. In contrast to this Nb shows a strong temperature dependence of γ. Below 14°K: $\gamma = 22.5 \times 10^{-4}$ with $\Theta = 250°$; above 100°K: $\gamma = 5.2 \times 10^{-4}$ with $\Theta = 286°$.

H.London

539.2

20753 EFFECTS OF s–d INTERACTION ON TRANSPORT PHENOMENA. T.Kasuya.

Progr. theor. Phys., Vol. 22, No. 2, 227-46 (Aug., 1959).

The effects of the so-called s–d interaction on transport phenomena of ferromagnetic metals and alloys are discussed. Electrical and thermal conductivities and thermoelectric effect are calculated with the simple molecular field approximation, and an anomalous thermoelectric effect is expected in these substances. At sufficiently low temperatures, the disordering of a spin system is described by the collective mode of spin waves. Calculations are made of transport coefficients using the spin-wave approximation.

539.2

20754 THE LATTICE THERMAL CONDUCTIVITY OF DILUTE ALLOYS OF SILVER AND GOLD.

G.K.White, S.B.Woods and M.T.Elford.

Phil. Mag. (Eighth Ser.), Vol. 4, 688-92 (June, 1959).

The thermal conductivity of certain alloys was measured on samples which had been carefully annealed to reduce the concentration of dislocations. After subtraction of an electronic component estimated from the residual electrical resistivity, the remainder was proportional to T^2 below 10°K, and agreed with Makinson's calculation of the lattice conductivity, assuming that lattice waves of all three polarization interact equally with conduction electrons.

539.2 : 536.48

20755 THERMAL CONDUCTIVITY OF PURE INDIUM.

R.E.Jones and A.M.Toxen.

Phys. Rev., Vol. 120, No. 4, 1167-70 (Nov. 15, 1960).

The thermal conductivity was measured in the normal and superconducting states in the range of temperatures 1.3-4.2°K. In the normal state the specimen showed sizeable magnetothermal resistivity effects which were not in agreement with Kohler's rule for thermal conductivity. Near the transition temperature the rat of conductivities K_s/K_n exhibited the finite slope with temperatur characteristic of electronic conduction limited by phonon scatterin The results were compared with a simple model proposed by Kadanoff and Martin and the agreement was found to be good.

539.2 : 5

20756 THE THERMAL CONDUCTIVITY OF GERMANIUM, SILICON AND INDIUM ARSENIDE FROM 40°C TO 425°

A.D.Stuckes.

Phil. Mag. (Eighth Ser.), Vol. 5, 84-99 (Jan., 1960).

Measurements were made of the thermal conductivity of germa nium, silicon, pure ($n=3 \times 10^{16}$) indium arsenide and impure (n=10 indium arsenide. In each case the electronic contribution k_e to thermal conductivity has been calculated and the phonon contributio k_l estimated by subtraction of k_e from the experimental values. Th thermal resistance of the lattice has not generally been found to be proportional to the absolute temperature as expected for three-pho processes but the trend is towards a higher power relationship. Th lattice resistance of heavily doped indium arsenide was found to be greater than that of the pure material.

539.2 : 536

20757 THE THERMAL CONDUCTIVITY OF IMPURE InAs AT HIGH TEMPERATURES. F.W.Sheard.

Phil. Mag. (Eighth Ser.), Vol. 5, 887-98 (Sept., 1960).

The addition of impurities affects both the lattice and electroni thermal conductivities of a semiconductor. At high temperatures the lattice resistance is increased by an amount independent of tem perature: for the small concentrations normally present in semiconductors the impurity resistance can be derived very simply fro the variational principle. The electronic contribution is normally obtained from the electrical conductivity via a Lorentz number. Fo a degenerate electron gas, assuming that polar scattering dominate an approximate calculation shows that at high temperatures the Lorentz number can be considerably reduced below the "standard" value $L_0=(\pi^2/3)(k/e)^2$. These theoretical calculations do not comple tely agree with the observed conductivity of impure InAs between 300° and 700°K (see preceding abstract). The disagreement is attr buted to the electronic contribution. To give agreement the Lorent number would have to be reduced further but the precise amount is uncertain owing to experimental errors.

539

20758 A NEW TYPE OF OSCILLATION OF THE ABSORPTIO COEFFICIENT OF ULTRASOUND IN A MAGNETIC FIELD. A.A.Galkin, E.A.Kaner and A.P.Korolyuk.

Dokl. Akad. Nauk SSSR, Vol. 134, No. 1, 74-6 (Sept. 1, 1960). In Russian.

It was found that the absorption of 220 Mc/s ultrasound in tin passed through a number of successive maxima and minima as the applied magnetic field H was increased. The number of peaks was linearly related to 1/H. The results were interpreted in terms of the interaction between the wave motion and the motion of the electrons in the magnetic field.

R.F.S.Hearm

5

20759 ACOUSTOELECTRIC EFFECT IN METALS. N.Mikoshiba.

J. Phys. Soc. Japan, Vol. 14, No. 12, 1691-5 (Dec., 1959).

A classical Boltzmann theory is given of the acoustoelectric effect in monovalent metals, using Pippard's approach (Abstr. 949 of 1955), to the ultrasonic absorption by conduction electrons. Weinreich's phenomenological relation (Abstr. 9578 of 1957), betw the acoustoelectric effect and the ultrasonic absorption holds in al frequency ranges for both longitudinal and transverse ultrasonic waves. For longitudinal waves in the intermediate and high freque ranges, the result is essentially identical with that derived from t quantum-mechanical calculation. The order of magnitude of the acoustoelectric effect in the low frequency range is smaller than Parmenter's result (Abstr. 4399 of 1959), but larger than that obtained by Weinreich-Holstein's approach. A phenomenological the is developed of the acoustoelectric effect due to an electron transf mechanism in polyvalent metals; the method can also be applied t many-valley semiconductors. Similarities with the work of Blount (Abstr. 8807 of 1959) are noted.

539.2 : 536.

ULTRASONIC ATTENUATION IN METALS AT LOW TEMPERATURES. See Abstr. 19581

539.2 : 537.52

20760 THE PHONON DRAG COMPONENT OF THE THERMOELECTRIC POWER OF THE ALKALI METALS AT V TEMPERATURES. M.Bailyn.
.. Mag. (Eighth Ser.), Vol. 5, 1059-85 (Oct., 1960).

The theory of phonon drag in the thermoelectric power is eloped from an equation derived in a previous paper. It is shown important in the understanding of the phenomena are the relative babilities $\alpha(j\vec{q};\vec{q}+\vec{K})$ that a phonon of wave-vector $\vec{q}$ and polarion j will interact with electrons via a process of umklapp type where $\vec{K}$ is a reciprocal lattice vector or zero; $\alpha(jq;\vec{q}+\vec{K})$ is the bability relative to all the processes into which the jq phonons enter, including phonon—phonon collisions and phonon—impurity eractions. It is shown by means of a "baby spectrum" that the of α results in the domination of the phonon drag effect by the nsverse-like phonon modes, and in the watering down of any lge" effect of the Fermi surface. Rough calculations are made t show that one can get qualitative agreement with experiment r at least part of the temperature range from 2 to 20° K. It is wn that with neglect of phonon—phonon and phonon—impurity eractions the phonon drag part S_g of the thermoelectric power is sum of two terms, a normal (negative) term S_g^-, which is ctly what would be calculated if all processes were non-umklapp ocesses, plus a term S_g^+ which is anomalous (positive) in sign and the effect on the electrons of the Bragg reflections abstracted m the umklapp processes. A simple derivation of the basic ation is given.

539.2

20761 MANY-ELECTRON THEORY OF IONIC CRYSTALS. S.V.Vonsovskii and M.Sh.Giterman.
. tverdogo Tela, Vol. 2, No. 8, 1793-1805 (Aug., 1960). Russian.

The energy spectra of the boson and fermion branches of fundantal excitations are obtained with allowance for electron—electron electron—phonon interactions. The general theory is applied to larons, anomalies of the kinetic coefficients near the Curie point ferromagnetic and antiferromagnetic semiconductors, and the citon Stark effect. A.Tybulewicz

539.2

20762 EQUIVALENT HAMILTONIAN OF AN ELECTRON GAS AT HIGH DENSITY. T.Nishiyama.
rogr. theor. Phys., Vol. 20, No. 2, 245-6 (Aug., 1958).

Proposes a small alteration in Wentzel's equivalent Hamiltonian ethod (Abstr. 5102 of 1958), ionic motion now being represented by harmonic oscillation at the plasma frequency. A formula for the fect of this ionic oscillation on the correlation energy is also given. O.Penrose

539.2

20763 EFFECT OF TEMPERATURE ON THE CHARACTERISTIC ENERGY LOSSES OF ELECTRONS IN IRON.
B.Borovskii, A.N.Kabanov, Yu.M.Kushnir and V.V.Schmidt.
h. eksper. teor. Fiz., Vol. 38, No. 5, 1383-7 (1960). In Russian.

During a phase transition of the first kind ($\alpha \rightarrow \gamma$-transition) discontinuity was observed to appear in the characteristic energy sses of electrons in iron. The phenomenon is treated from the iewpoint of the plasma model.

539.2

20764 HIGH-PRESSURE ANOMALIES OF ELECTRON PROPERTIES OF A METAL. I.M.Lifshitz.
h. eksper. teor. Fiz., Vol. 38, No. 5, 1569-76 (1960). In Russian.

A peculiar "electron transition" due to variation of the Fermi rface topology during its continuous deformation may occur in etals at high pressures. At the point of such a transition the elecon state density near the metal surface and the electron dynamics ssess some peculiar features which lead to anomalies of the elecon properties of a metal (thermodynamic and kinetic). The most aracteristic anomalies in the vicinity of the "electron transition" int were investigated at low temperatures. The possibility of an omorphic transition of the first kind near the "electron transition" int is discussed

539.2

20765 THE FERMI SURFACE IN WHITE TIN. A.V.Gold and M.G.Priestley.
hil. Mag. (Eighth Ser.), Vol. 5, 1089-104 (Nov., 1960).

The orientation dependence of the de Haas—van Alphen periods tin single crystals was studied in high pulsed magnetic fields. As many as seven periods were found at some orientations, indicating that the Fermi surface is much more complicated than the three-ellipsoid model suggested by Fawcett (1955). The general degree of complexity of the results was much the same as that predicted by the free-electron model, but serious discrepancies were found when a detailed comparison is made. Effective-mass values were determined at the principal orientations from the temperature dependence of the amplitudes; these were compared with the results of cyclotron resonance experiments and with the free-electron orbit masses.

539.2

20766 AN APPROXIMATE CORRELATION BETWEEN THE ELECTRON FERMI ENERGY AND WORK FUNCTION OF A METAL. J.H.O.Varley.
Phil. Mag. (Eighth Ser.), Vol. 5, 64-9 (Jan., 1960).

An estimate is made, semi-empirically, the Fermi energy of the free electrons in a metal and it is indicated, why a simple correlation may be expected between this quantity and the electronic work function. Such a straightforward correlation is found to hold approximately for most metals in Groups I to IV of the periodic table.

539.2

20767 DETERMINATION OF THE FERMI VELOCITY BY THE HIGH-FIELD TILT EFFECT. H.N.Spector.
Phys. Rev., Vol. 120, No. 4, 1261-5 (Nov. 15, 1960).

The attenuation of a sound wave in a semimetal in the presence of a magnetic field is examined when the magnetic field is tilted from the direction perpendicular to the direction of propagation of the sound wave. It is found that in the limit of high magnetic fields ($\omega_c\tau \geq 10ql$) the behaviour of the attenuation with the angle of tilt gives a point-by-point determination of the velocity on the Fermi surface. A detailed treatment of a two-spherical-band model is given and the case of a general Fermi surface is examined qualitatively.

539.2

20768 NUMBER OF 3D ELECTRONS IN IRON. S.K.Joshi.
J. chem. Phys., Vol. 33, No. 4, 1261 (Oct., 1960).

The number of free electrons, n_0, in iron can be estimated on the basis of the lattice theory of elastic constants, since a tightly bound d-electron contributes a primarily central force following the Cauchy relation $c_{12} = c_{44}$. Hence a difference between c_{12} and c_{44} arises through the free electrons. One can thus calculate that n_0 in Fe is about 0.6 and the number of 3 d electrons would be 7.4. L.Pincherle

539.2 : 539.18

20769 UNRESTRICTED HARTREE—FOCK METHOD: ELECTRON DENSITIES AND MAGNETIC FORM FACTORS FOR SPIN POLARIZED Ni^{++}.
R.E.Watson and A.J.Freeman.
Phys. Rev., Vol. 120, No. 4, 1125-34 (Nov. 15, 1960).

The effect of relaxing the restrictions associated with the Hartree—Fock method are discussed with particular emphasis on that constraint which requires common radial behaviour for wave-functions with all quantum numbers except m_s (spin direction) in common. Results of such a "spin polarized" Hartree—Fock self-consistent field calculation are reported for the Ni^{2+} ion and related to earlier calculations of Wood and Pratt (Abstr. 9834 of 1957) and Heine (Abstr. 9835 of 1957). Emphasis is placed on a consideration of the effects on the electron density and on X-ray and magnetic form factors. As is discussed, spin polarization of the 3d shell and the core results in an interesting effect on the magnetic form factor for this case. The calculation suggests that one would obtain a magnetic form factor which is measurably expanded (hence, a contracted charge distribution) in comparison with that appropriate for any single 3d electron. Also presented are results of calculations of several hyperfine parameters which are in rough agreement with experiment. See also following abstract.

539.2

20770 CRYSTALLINE FIELD AND SPIN POLARIZATION EFFECTS ON ELECTRON DENSITIES AND MAGNETIC FORM FACTORS. R.E.Watson and A.J.Freeman.
Phys. Rev., Vol. 120, No. 4, 1134-41 (Nov. 15, 1960).

The combined effects of spin (or exchange) polarization and an external crystalline field on charge densities, X-ray and magnetic form factors, and hyperfine parameters are investigated following the analytic Hartree—Fock self-consistent field approach. The crystalline field was represented by a crude cubic field arising from an octahedral array of point charges surrounding the central ion — in this case Ni^{2+}. In the strong field approximation the atomic 3d electrons are "split" by the crystalline field and the spin polarization effect, resulting in a description of these electrons by a set of three distinct orbitals (each having different radial distributions and called $t_{2g}\uparrow$, $t_{2g}\downarrow$ and $e_g\uparrow$). The ion's spin density leads to a Fermi contact hyperfine term in better agreement with experiment than the value reported in an earlier spin polarized calculation for the free Ni^{2+} ion and a magnetic form factor whose Fourier transform resembles none of the individual 3d charge distributions.

539.2

20771 3d BAND STRUCTURE OF SOME TRANSITION ELEMENTS. E.F.Belding.

Phil. Mag. (Eighth Ser.), Vol. 4, 1145-8 (Oct., 1959).

Tight-binding calculations of the structure of the 3d band for Cr, Fe and Ni, using the interaction of both nearest and second nearest neighbours show a broadening of the 3d band at the lower energy limit for the body-centred cubic elements due to the second nearest neighbour interaction but a negligible effect on face-centred cubic Ni.

539.2 : 536.48

20772 THE DENSITY OF STATES IN LEAD. A.V.Gold.

Phil. Mag. (Eighth Ser.), Vol. 5, 70-7 (Jan., 1960).

Refinements of the curve of density of states n(E) in lead, as deduced from the de Haas—van Alphen effect, are inferred from existing superconductivity and transport data on pure lead and on Pb—Tl and Pb—Bi alloys when these data are interpreted in terms of a simple "inverse transition metal" model. n(E) is found to have a maximum just below the Fermi level. It is suggested that the maximum might be accounted for by supposing the multiply-connected portion of the Fermi surface to split up into separate portions as the electron concentration is reduced; however, this particular interpretation does not seem to be compatible with a model of rigid bands.

539.2

20773 ELECTRON LEVELS IN A ONE-DIMENSIONAL RANDOM LATTICE. H.L.Frisch and S.P.Lloyd.

Phys. Rev., Vol. 120, No. 4, 1175-89 (Nov. 15, 1960).

Let the potential of a one-dimensional particle be

$$V_0(x) = V_0\Sigma_{-\infty}^{\infty}\delta(x-x_j), \quad -\infty < x < \infty,$$

where $V_0 < 0$, and where the sequence (x_j) is random, with a Poisson distribution. The quantity of interest is a certain limiting level distribution, equal numerically to the mode density of real solutions $\psi(x)$ of the Schrödinger equation. The random variables

$$z_j = \psi'(x_j-0)/\psi(x_j), \quad -\infty < j < \infty,$$

constitute an ergodic stationary Markov process. The stationary density T(z) of the (z_j) satisfies a first-order linear differential-difference equation, and the node density is given (with probability 1) by $\lim_{z\to\infty} z^2T(z)$ (Rice's formula). Numerical results are obtained by integrating the second-order linear differential equation satisfied by the Fourier transform of T(z).

539.2 : 539.18

ENERGY SHIFTS OF L-LEVELS IN SOME 5th PERIOD ELEMENTS DUE TO OXIDATION AND ALLOYING.

See Abstr. 7690

539.2 : 539.18

ENERGY LEVEL SCHEME OF SOLID POTASSIUM.

See Abstr. 20594

539.2

20774 BAND STRUCTURE CALCULATIONS IN SOLIDS. L.Pincherle.

Rep. Progr. Phys., Vol. 23, 355-94 (1960).

After a brief review of the main experimental evidence on the electronic band struture of solids, the various methods for calculating band structures, either from first principles or from empiric data, are classified and critically examined. Finally the problem of the construction of the crystal potential is discussed in an elementary way.

539.2

20775 STUDY OF THE TRANSITIONS BETWEEN METALLIC AND INSULATING STATES. APPLICATION TO IMPURITY BANDS AND ANTIFERROMAGNETICS. II.

J. des Cloizeaux.

J. Phys. Radium, Vol. 20, No. 8-9, 751-63 (Aug.-Sept., 1959).

Under definite assumptions, an electron gas in a solid may behave as an insulator in contradiction to the predictions of band theory. A simple model was proposed in Pt I (see Abstr. 17909 of 1960). A more careful study gives the same results but shows that besides individual excitations there are two kinds of collective excitations: plasmons and spinons. An application of the model to disordered systems is discussed.

539.2

20776 NEUTRON SCATTERING AND STARK EFFECT IN CRYSTALLINE RARE EARTH OXIDES.

D.Cribier and B.Jacrot.

C.R.Acad. Sci. (Paris), Vol. 250, No. 17, 2871-3 (April 25, 1960). In French.

Neutron inelastic scattering was used to measure the decomposition of fundamental levels of magnetic rare earth ions in the crystal field. The observed transitions in Ho_2O_3 are 365 and 76 cm and in Er_2O_3 are 420, 81 and 40.5 cm^{-1}. J.Adam

539.

20777 SCATTERING OF THERMAL NEUTRONS IN ALUMINIUM. L.S.Kothari.

Phil. Mag. (Eighth Ser.), Vol. 4, 1325-38 (Dec., 1959).

In order to investigate theoretically the scattering of thermal and cold neutrons by crystals, one normally uses the Debye spectrum for the lattice vibrations and assumes the velocity of sound in the medium to be constant. Taking a more realistic model (suggested by the Born—von Kármán theory) for the dispersion relation and the frequency distribution function, a calculation is made of the inelastic scattering cross-section for cold neutrons, and it is shown, in the particular case of aluminium, that the results agree well with experimental data. The scattering surface for long-wavelength neutrons is also obtained and agrees well with the calculation of Squires (Abstr. 4634 of 1952; 7012 of 1956).

539.

20778 BINDING AND DECAY OF A MOTT EXCITON TAKING INTO ACCOUNT THE EXACT COULOMB FUNCTIONS.

A.A.Lipkin.

Fiz. tverdogo Tela, Vol. 2, No. 9, 2044-7 (Sept., 1960). In Russian.

It is shown that a previous calculation of the probabilities of decay and binding was in error because of the approximation of the continuous spectrum by a plane wave. The probabilities are here calculated with the exact Coulomb functions (assuming weak Coulomb screening). Results are tabulated for two sets of values of the parameters, corresponding to Ge and Cu_2O. R.Berma

539.2

20779 THE EXCITON FOR INTERMEDIATE BINDING TAKING TRANSLATION INTO ACCOUNT. I.G.Zaslavskaya.

Fiz. tverdogo Tela, Vol. 2, No. 9, 2243-7 (Sept., 1960). In Russian.

The energy of the ground state of an exciton, calculated by the method of intermediate binding (Abstr. 2154, 5656 of 1958), is lowered when translational symmetry is taken into account. An expression for the effective mass is given. R.Berma

539

20780 EXCITON STRUCTURES IN ALKALI HALIDES. Y.Osaka.

J. Phys. Soc. Japan, Vol. 14, No. 12, 1685-90 (Dec., 1959).

Exciton structures in alkali halides are analysed according to the p^5d configurations based on the "transfer" model for an exciton. The ratio of intensity of the absorption peak which is estimated fro the p^5d configuration is calculated for some values of parameters. Qualitative comparison with experiment is given.

539.

20781 SPIN—LATTICE RELAXATION OF AN EXCITON IN AN IONIC CRYSTAL. V.N.Paranichev.

Optika i Spektrosk., Vol. 9, No. 1, 117-19 (July, 1960). In Russian.

Due to the interaction of the exciton spin with the optical vibrations of the lattice, transitions are possible from one multiplet stat into another with simultaneous emission or absorption of a phonon. A calculation is given of the exciton lifetime for such transitions. A.Tybulewic

539.2

20782 RELATION BETWEEN THE STRUCTURE OF EXCITON BANDS AND NATURAL OPTICAL ACTIVITY OF

C STALS. Yu.A.Tsvirko.
Z eksper. teor. Fiz., Vol. 38, No. 8, 1615-19 (1960). In Russian.

The structure of degenerate exciton bands in uniaxial crystals is onsidered. Expressions are derived for the dispersion of optical a ity (optical rotation) due to intersection of exciton energy surf s.

539.2

783 POLARON STATE AT A FINITE TEMPERATURE. Y.Ōsaka.
P gr. theor. Phys., Vol. 22, No. 3, 437-46 (Sept., 1959).

The treatment of Feynman (Abstr. 3261 of 1955) for the polaron p lem at 0° K is extended to the case at a finite temperature. A v iational principle is applied to the free energy of the polaron s e.

539.2

0784 CYCLOTRON RESONANCE IN LEAD. J.E.Aubrey.
. Mag. (Eighth Ser.), Vol. 5, 1001-12 (Oct., 1960).

Cyclotron resonance effects of the Azbel'—Kanner type (1956, 1 7) were observed in lead specimens at 9 kMc/s and 1.2°K, and e ctive mass values of the charge carriers were deduced from magnetic field dependence of the surface resistance of the spe- ens. The anisotropy of the surface conductivity of the single- stal specimens in the low-field limit was found to be consistent the existing model of the Fermi surface in lead, and from the ie of the surface conductivity of a polycrystalline specimen, a ie of the total Fermi surface area was found which supports the w that the fourth Brillouin zone in lead is empty.

539.2

20785 VALENCE BAND PARAMETERS IN SILICON FROM CYCLOTRON RESONANCES IN CRYSTALS SUBJECTED UNIAXIAL STRESS. J.C.Hensel and G.Feher.
s. Rev. Letters, Vol. 5, No. 7, 307-9 (Oct. 1, 1960).

The warped and degenerate valence band can be split into two eroidal bands by uniaxial stress along [001] or [111]. Using esses of about 1000 kg/cm^2, the effective masses of these bands re measured, and the three effective-mass parameters of the ence band so deduced. R.G.Chambers

539.2 : 539.14

20786 NUCLEAR ORIENTATION AND THE HYPERFINE STRUCTURE COUPLING IN COBALT METAL.
A.Grace, C.E.Johnson, N.Kurti, R.G.Scurlock and R.T.Taylor.
il. Mag. (Eighth Ser.), Vol. 4, 948-56 (Aug., 1959).

The hyperfine structure coupling for cobalt in hexagonal cobalt tal was determined using a nuclear orientation technique. The erfine structure coupling, represented as an effective magnetic ld H_{eff} at the nucleus, is given by $H_{eff} = 193 \pm 20$ kG.

539.2 : 539.16

20787 POLARIZATION OF Sc^{46} IN IRON. A.V.Kogan, V.D.Kul'kov, L.P.Nikitin, N.M.Reinov, .Sokolov and M.F.Stel'makh.
. eksper. teor. Fiz., Vol. 39, No. 1(7), 47-52 (July, 1960). Russian.

The γ-ray asymmetry of polarized Sc^{46} nuclei in an alloy with re iron was measured at $(1.5 - 3) \times 10^{-2}$ °K. The effect observed dicates that the introduction of scandium into the ferromagnetic bstance leads to the appearance of an effective magnetic field H_{eff} the order of 10^5 Oe which acts on the nucleus. In the case of Co, e effective field is $(3-4) \times 10^5$ Oe.

539.2

20788 THE HYPERFINE STRUCTURE OF γ-RAYS, DUE TO THE QUADRUPOLE INTERACTION IN A CRYSTAL ATTICE. N.N.Delyagin, V.S.Shpinel', V.A.Bryukhanov and .Zvenglinskii.
h. eksper. teor. Fiz., Vol. 39, No. 1(7), 220-2 (July, 1960). Russian.

The hyperfine structure of the 23.8 keV excited state of Sn^{119} as investigated, by means of a Mössbauer-type experiment in hich the velocity of the source changed linearly with time. The istance between the components of the hyperfine structure was und to be $(1.15 \pm 0.25) \times 10^{-7}$ eV, but lack of knowledge of the lectric field gradient in crystalline tin prevented the determination the quadrupole moment of the excited state. E.A.Sanderson

539.2 : 533.7 : 532.7 : 539.14 : 530.16

THEORY OF γ-RAY RESONANCE ABSORPTION IN SOLIDS.
e Abstr. 18992

539.2

20789 USE OF THE MÖSSBAUER EFFECT FOR THE INVESTIGATION OF LOCALIZED ATOMIC OSCILLATIONS IN SOLIDS. S.V.Maleev.
Zh. eksper. teor. Fiz., Vol. 39, No. 3(9), 891-2 (Sept., 1960). In Russian.

Discusses the possibility of observing and investigating atomic-oscillation peaks due to the emission and absorption of quanta of localized oscillations. E.A.Sanderson

Defect Properties

539.2

20790 DEFECTS IN THE CRYSTAL AND MAGNETIC STRUCTURES OF FERROUS OXIDE. W.L.Roth.
Acta cryst., Vol. 13, Pt 2, 140-9 (Feb., 1960).

The defect structure of non-stoichiometric FeO (wüstite) was investigated by measuring the neutron scattering of powders quenched from the high temperature equilibrium state. The nuclear scattering shows the defects to consist of both cation vacancies in octahedral sites and interstitial cations in tetrahedral sites. The defects give rise to diffuse scattering which suggests the atomic arrangement in the vicinity of the defect is similar to that in magnetite. The average magnetic moment of iron atoms in normal positions, obtained by measuring the scattering of neutrons by the periodic arrangement of spins in the antiferromagnetic state, indicate the magnetic structure in the vicinity of the defect is paramagnetic. The model is supported by magnetic studies which demonstrated the existence at low temperature of a magnetic remanence in exchange contact with the antiferromagnetic structure.

539.2

20791 CLUSTERED VACANCY DEFECTS IN SOME FACE-CENTRED CUBIC METALS AND ALLOYS.
R.E.Smallmann, K.H.Westmacott and J.H.Coiley.
J. Inst. Metals, Vol. 88, Pt 3, 127-33 (Nov., 1959).

Recent experiments by small-angle X-ray scattering (Abstr. 7510 of 1959) and transmission electron microscopy (Abstr. 1873 of 1959) have demonstrated conclusively the aggregation of vacancies in quenched metals. Since the transmission electron-microscope studies on aluminium, further observations have been made on clustered vacancy defects produced in various metals of different stacking-fault energies and by other means, in particular by (a) precipitation-hardening and (b) neutron-irradiation treatments. Four different types of clustered vacancy defect have been observed: (i) prismatic dislocation loops, (ii) stacking-fault tetrahedra, (iii) spiral dislocations, and (iv) prismatic loops aligned in rows. The conditions governing the formation of each of these defects are discussed and their practical significance briefly mentioned.

539.2

20792 DETECTION OF EQUILIBRIUM VACANCY CONCENTRATIONS IN ALUMINIUM.
S.Nenno and J.W.Kaufman.
Phil. Mag. (Eighth Ser.), Vol. 4, 1382-4 (Dec., 1959).

The change in lattice parameters of pure Al was measured and compared with published bulk thermal expansion data. From the difference of these, the vacancy concentration at the melting point was found to be $(1.1 \pm 0.2) \times 10^{-3}$ and the energy of vacancy formation (0.64 ± 0.12) eV. H.Mykura

539.2

20793 A NEW CASE OF CRYSTALLOGRAPHIC STACKING FAULT: U_3O_{8-x}. R.Sato.
Nature (London), Vol. 188, 222-3 (Oct. 15, 1960).

Electron-diffraction photographs showed stacking faults in a specimen prepared by partial reduction of U_3O_8 to UO_2 by heat treatment. A.R.Stokes

539.2

20794 THE ELECTRICAL RESISTIVITY OF STACKING FAULTS. A.Howie.
Phil. Mag. (Eighth Ser.), Vol. 5, 251-71 (March, 1960).

The scattering of electrons and X-rays by stacking faults is due to a phase change in the diffraction by crystal planes which do not lie parallel to the fault. A simple model of the process in copper estimates a resistivity $\rho \cong 1 \times 10^{-12}\,\beta$ ohm cm for a total stacking fault density of β cm^{-1} on all planes. A wave matching calculation in which Tamm surface waves are used confirms the order of magnitude of the effect and is also in agreement with the prediction of the simple model that the distance over which scattering from two faults could interfere is less than the lattice spacing. These results are consistent with the available experimental data and it is concluded that the effect explains the resistivity caused by extended dislocations in cold worked metals and by tetrahedra of stacking faults in quenched metals.

539.2

20795 EFFECT OF POINT IMPERFECTIONS ON LATTICE THERMAL CONDUCTIVITY.

J.Callaway and H.C.von Baeyer.
Phys. Rev., Vol. 120, No. 4, 1149-54 (Nov. 15, 1960).

The consequences of a simple, phenomenological, theory of lattice thermal conductivity with respect to the effect of point imperfections are summarized. The experimental results of Berman et. al on the effect of varying the concentration of Li^6 on the conductivity of lithium fluoride are analysed in detail.

539.2 : 530.16

RELATION BETWEEN DIRAC AND CANONICAL DENSITY MATRICES, WITH APPLICATIONS TO IMPERFECTIONS IN METALS. See Abstr. 18993

539.2

20796 A STUDY OF GROWTH DEFECTS IN FACE-CENTRED CUBIC METAL FOILS PREPARED BY EVAPORATION.

J.W.Matthews.
Phil. Mag. (Eighth Ser.), Vol. 4, 1017-29 (Sept., 1959).

Single crystal foils of copper, silver and gold were prepared by evaporation of the metal onto the cleavage face of a hot rock salt crystal. Examination of the foils in a transmission electron microscope showed the presence of dislocations and stacking faults. Many of the stacking faults had part of their area on one $\{111\}$ plane and the remainder on another. A number of defects which involved three faulted planes were also observed. In addition, the foils contained dislocation loops and tetrahedral stacking faults similar to those discovered recently in quenched metals. The formation of defects during film growth has been considered. Stacking faults result from the coalescence of "out of phase" metal nuclei. Experimental evidence for this is presented.

539.2

20797 QUENCHING DEFECTS IN BINARY ALUMINIUM ALLOYS. G.Thomas.

Phil. Mag. (Eighth Ser.), Vol. 4, 1213-28 (Nov., 1959).

Thin foils of binary aluminium alloys containing various amounts of copper, silver, zinc and magnesium in solid solution were prepared from quenched specimens and examined by transmission electron microscopy. In all the alloys closed loops of dislocation line and complex dislocation networks were observed. The dislocation loops did not show any stacking fault contrast so they are glissile dislocations of prismatic $\frac{1}{2}\langle 110\rangle$ type. These loops are formed by the condensation of vacancies into collapsed discs and the results indicate that this often occurs during the quench. The vacancy concentrations required to produce the defects were calculated from the density and size of the loops and varied from 10^{-3} to 10^{-6} as the quenching temperature was decreased from 600° to 500° C and as the solute content was increased when quenching from the same temperature. This result led to the conclusion that most of the vacancies remain "quenched in" in the concentrated alloys, i.e. the supersaturation of vacancies decreases with increasing alloy content. The magnitude of this effect decreases in the order copper, silver, magnesium, zinc. This is also the order of increasing mobility of these elements in aluminium. At composition above 0.9 at.% Cu, 1.3 at.% Ag, 8 at.% Mg and >15 at.% Zn most of the vacancies may be retained in solution after quenching the alloys from 550° C. The precipitation of vacancies in the Al—Cu, Al—Ag and Al—Zn alloys is thought to be accompanied by clustering of solute atoms. The annealing process in Al--Mg alloys is complicated and there is no evidence for clustering of magnesium atoms. Dislocations and grain boundaries have been shown to be sinks for vacancies and the possibilities that these defects are also collectors for solute atoms is discussed. Helical dislocations were observed in quenched alloys only when the quenching temperature was close to the limit of solid solubility.

539.2

20798 POINT DEFECTS IN PLATINUM. G.R.Piercy.

Phil. Mag. (Eighth Ser.), Vol. 5, 201-21 (March, 1960).

An investigation was made of the mobility and types of point defect introduced in platinum by deformation in liquid nitrogen, quenching into water from 1600°C, or reactor irradiation at 50° In all cases the activation energy for motion of the defect was determined from measurements of electrical resistivity. Measu ments of density, hardness, and X-ray line broadening were also made where applicable. These experiments indicated that the principal defects remaining in platinum after irradiation were si vacant lattice sites and after quenching were pairs of vacant latt sites. Those present after deformation in liquid nitrogen were s vacant lattice sites and another type of defect, perhaps interstiti atoms.

5

20799 CALCULATION OF STORED ENERGY FROM BROADENING OF X-RAY DIFFRACTION LINES.

E.A.Faulkner.
Phil. Mag. (Eighth Ser.), Vol. 5, 519-21 (May, 1960).

A new calculation is made of the stored energy in a deforme isotropic material, in terms of the mean-square lattice strain. An isotropic stress distribution is assumed.

53

20800 THE PRESENCE OF DISLOCATIONS IN CRYSTALS. A.R.Weill.

J. Phys. Radium, Vol. 20, No. 7, 712-16 (July, 1959). In French.

Until 1949, the practical value of the dislocation theory was still questionable as no experiment had been able to give evidenc of this type of lattice defect. Within ten years experiments have been performed which not only check the theoretical predictions extend them much further. This is demonstrated in the recent pa listed in the bibliography presented here.

53

20801 THE DETECTION OF DISLOCATIONS BY LOW TEMPERATURE HEAT CONDUCTIVITY MEASUREMENTS. J.N.Lomer and H.M.Rosenberg.

Phil. Mag. (Eighth Ser.), Vol. 4, 437-83 (April, 1959).

The lattice heat conductivity of a specimen after straining is reduced by the dislocations produced by the deformation. A theo by Klemens enables the dislocation density to be calculated from decrease in the lattice conductivity at liquid helium temperatures In the present experiments copper—zinc single and polycrystals (7, 15 and 30% Zn) were deformed by various amounts and the increase in the dislocation density was determined by heat conducti measurements. The results are shown to be in qualitative agreement with current theories of work hardening. In stage I of the stress/strain curve there is only a slight increase in dislocation density, but there is a rapid increase in stage II. Whereas in bot these stages the dislocation density is independent of the zinc con the onset of stage III is strongly dependent on it. During stage III there is very little increase in dislocation density. In stage I the dislocation density is proportional to the stress, whereas in stag it is proportional to $(\text{stress})^2$. Transmission electron microscop experiments on some of the specimens show that the Klemens theory overestimates the dislocation density by a factor of about Comparison of electrical resistivity data with the lattice thermal conductivity results gives further evidence for suggesting that th electrical resistivity is affected by stacking faults rather than by dislocations. Experiments on specimens taken at various stages during a fatigue test show that the dislocation density increases during the first two hundred fatigue cycles, but thereafter it rem constant.

5

20802 HELICAL DISLOCATIONS IN QUENCHED ALUMINIUM--4% COPPER ALLOYS.

G.Thomas and M.J.Whelan.
Phil. Mag. (Eighth Ser.), Vol. 4, 511-26 (April, 1959).

Experiments by transmission electron microscopy on thin foils of polycrystalline Al—4% Cu alloys, quenched from variou temperatures have revealed helical dislocation lines which are thought to be produced by condensation of vacancies on dislocati of predominantly screw character. The axes of the helices are parallel to the Burgers vector, i.e. parallel to [110] directions. In material quenched from 500° C and 540° C the helical dislocati vary in radius and pitch from about 250 A to more than 1500 A. Material quenched from 440° C contains irregular helices with pitch several hundred angstroms and much smaller radius. Preliminary estimates suggest that the vacancy concentration requi to produce the observed climb is $\sim 3 \times 10^{-5}$ (500° and 540° C ıches) and ~2 × 10^{-6} (440° C quench). The helices appear to ract with each other and with other dislocations to produce rtwined helices and rows of loops. Observations of connected ces of opposite hand and of the lengths of helical dislocations gest that loops from sources of slip active during quenching may ery elongated with long screw components. Dislocation loops also observed. Some appear to be formed by interaction of ces, others from collapsed vacancy discs. The latter occur ome areas in bands parallel to the traces of {111} planes and thought to be associated with slip bands. Elsewhere very few apsed vacancy discs are observed. The observations suggest nucleation of loops in the quenched alloy may be a difficult cess, and that some vacancies may remain quenched in. The ervations are also discussed in relation to precipitation effects.

539.2

20803 SOME DISLOCATION INTERACTIONS IN SIMPLE IONIC CRYSTALS. B.H.Kear, A.Taylor and P.L.Pratt.
l. Mag. (Eighth Ser.), Vol. 4, 665-72 (May, 1959).

Dislocation intersections in ionic crystals can produce both rged and uncharged jogs, as well as vacancies and interstitial s. Dislocation reactions helped by the retarding effect of these s, can give rise to sessile dislocations by a zip-fastening chanism. In this way the formation of boundaries during vational twinning may be explained.

539.2

20804 DISLOCATION STRUCTURES OBSERVED IN HIGH-PURITY RECRYSTALLIZED ALUMINIUM BY X-RAY FFRACTION. A.R.Lang and G.Meyrick.
il. Mag. (Eighth Ser.), Vol. 4, 878-80 (July, 1959).

Reports some preliminary results on the crystal perfection, as served by X-ray diffraction methods (Abstr. 7607 of 1959) of me crystals of very pure aluminium. The X-ray examination dicates a quite low dislocation density, in the range 10^4 to 10^5 es per cm^2 within the subgrains. Several particular dislocation atures, such as helices, rows of loops and isolated loops, were so found, but the principle imperfection is believed to be small riations in lattice parameter caused by irregularly distributed purities. R.Bullough

539.2

20805 DISLOCATION LOOPS IN NEUTRON-IRRADIATED COPPER. J.Silcox and P.B.Hirsch.
nil. Mag. (Eighth Ser.), Vol. 4, 1356-74 (Dec., 1959).

Electron transmission microscope observations were carried t on copper irradiated with neutrons at temperatures of 35° C and)°-100° C, and subsequently thinned by electropolishing. Speciens irradiated to a dose of 6.7 × 10^{17} cm^{-2} (at 35° C) contain 3 × 10^{15} defects cm^{-3} in the form of small regions of strain verage diameter ~75 A), some of which can be resolved as slocation loops. With increasing dose of irradiation (5.6 × 10^{18}, 4 × 10^{20}n cm^{-2}) many more of the defects can be recognized as ops, and their average diameter increases to ~150 A and ~300 A, espectively. The dislocation density in the form of loops is 0^{10}-10^{11} cm^{-2}. The stability of the loops and their behaviour on nnealing are as expected from prismatic loops. The loops are onsidered to nucleate as a result of the collapse of disks of acancies produced by vacancy clustering in the central region of displacement spike, and to grow by migration of vacancies or f vacancy clusters. Radiation hardening is interpreted in terms f the large density of dislocations in the form of loops. The ardening anneals out at the same temperature at which the loops re observed to disappear by climb.

539.2

20806 DIRECT OBSERVATIONS OF THE ANNEALING OF PRISMATIC DISLOCATION LOOPS AND OF CLIMB OF SLOCATIONS IN QUENCHED ALUMINIUM.
Silcox and M.J.Whelan.
hil. Mag. (Eighth Ser.), Vol. 5, 1-23, (Jan., 1960).

A high temperature stage fitted to a Siemens Elmiskop 1 elecron microscope was used to study directly the annealing of prismatic slocation loops in thin foils prepared from quenched and aged bulk pecimens of aluminium. In the temperature range 170-200° C the ops are observed to shrink and eventually to disappear. Observaons on dislocations other than loops also present in the thin foils how that they become smoother while the loops are disappearing. he results are interpreted in terms of climb of dislocations by acancy emission, and in the case of loops in thin foils, where vacncy supersaturation effects are thought to be negligible, the climb rate is governed by the line tension and curvature of the loops. The radius r of a loop as a function of time t is given by the theoretical expression

$$r = r_0[1-(t/\tau)]^{1/2}$$

where τ is the lifetime of a loop of initial radius r_0. The temperature dependence is primarily $\tau = \tau_0 \exp(E/kT)$, where E is the activation energy of self-diffusion. Comparison with experiment gives estimates of the activation energy in the range 1.2-1.3 eV. Annealing experiments with bulk material were carried out in parallel with the above experiments. They show that the loops anneal out in the same temperature range. The details are different however owing to vacancy supersaturation effects. Larger loops appear to grow at the expense of smaller ones. The theory gives a qualitative explanation of the annealing of electrical resistivity in quenched aluminium observed by other workers, although the shape of the isothermal annealing curve is difficult to predict quantitatively, owing to its dependence on the complex annealing behaviour of loops in bulk material. The experiments also suggest that the temperature rise of thin foils examined in the electron microscope due to heating by the electron beam is very small.

539.2

20807 THE GENERATION OF DISLOCATION LOOPS AT THE SURFACES OF CRYSTALS OF SILVER BROMIDE.
J.T.Bartlett and J.W.Mitchell.
Phil. Mag. (Eighth Ser.), Vol. 5, 445-50 (May, 1960).

A method for preparing chemically sensitized, dislocation-free silver bromide single crystals is described in this paper. When these crystals are strained beyond the elastic limit and exposed to light, both the dislocation loops which are generated at the surfaces, and the surface terraces which may be associated with them, are made visible by the separation of particles of silver. The glide planes of the dislocations may then be determined from microscopic measurements and the Burgers vectors of the dislocations may be inferred if the stress distribution responsible for the deformation is at least qualitatively known. This provides a powerful method for studying dislocation interactions and the fundamental processes of plastic deformation.

539.2

20808 PYRAMIDAL GLIDE AND THE FORMATION AND CLIMB OF DISLOCATION LOOPS IN NEARLY PERFECT ZINC CRYSTALS. P.B.Price.
Phil. Mag. (Eighth Ser.), Vol. 5, 873-86 (Sept., 1960).

Zinc whiskers and platelets with a (0001) orientation and thin enough ($<\sim \frac{1}{2}\mu$) to be transparent to 100 kV electrons were deformed in tension inside the electron microscope and the motion of individual dislocations followed by the transmission technique. These observations were then related to the macroscopic properties as determined by stress—strain curves. The crystals, which were found to be initially free of dislocations, deformed mainly by twinning (which is not considered here) or by pyramidal glide on the $(11\bar{2}2)$ $[\bar{1}\bar{1}23]$ system. Dislocations with three types of Burgers vectors were produced: long $\langle\bar{1}\bar{1}20\rangle$ dislocations which were easily immobilized and contributed very little to the deformation; short $\langle\bar{1}\bar{1}23\rangle$ screw dislocations which caused pyramidal glide and sometimes left behind long, narrow $\langle\bar{1}\bar{1}23\rangle$ loops which then split up into circular loops with the same Burgers vector; and circular $\langle 0001\rangle$ loops which were formed from $\langle\bar{1}\bar{1}23\rangle$ loops by the reaction $\frac{1}{3}\langle\bar{1}\bar{1}23\rangle \rightarrow \frac{1}{3}\langle\bar{1}\bar{1}20\rangle + \langle 0001\rangle$. Both types of loops were sessile but disappeared by climb at room temperature at a rate which agreed with the predicted rate. The loops impeded the motion of dislocations and were responsible for the propagation of glide as a Lüders band.

539.2

20809 THE SPACING OF PRISMATIC DISLOCATION LOOPS. R.Bullough and R.C.Newman.
Phil. Mag. (Eighth Ser.), Vol. 5, 921-6 (Sept., 1960).

The stresses round a circular prismatic dislocation loop are determined and used to calculate the spacings between such loops in a row generated from a source of internal stress. The results are consistent with the available experimental observations.

539.2

20810 ON THE STABILITY OF THE DISLOCATION SUB-STRUCTURE IN QUENCHED ALUMINIUM.
R.Vandervoort and J.Washburn.
Phil. Mag. (Eighth Ser.), Vol. 5, 24-9 (Jan., 1960).

Dislocation loops formed by quenching thin aluminium specimens in iced brine were studied by the transmission electron microscope technique. As-quenched specimens contained loops 200 to 600 A in diameter with a density of 10^{15} loops/cm^3. Quenched-in loops were completely removed by heating to 200° C for 10 min. or by cold rolling to a 5% reduction in thickness. The disappearance of the loops was accompanied by an increase in the number of irregular kinked dislocation lines.

539.2

20811 DISLOCATION-LOCKING BY CARBON, NITROGEN AND BORON IN α-IRON. I.Codd and N.J.Petch.
Phil. Mag. (Eighth Ser.), Vol. 5, 30-42 (Jan., 1960).

It is shown experimentally that nitrogen-locking is appreciably stronger than carbon-locking. This is contrary to the customary assumption and it is suggested that there may be chemical as well as elastic interaction with the dislocations. Boron is found to produce even stronger locking than nitrogen. These variations in the locking strength alter the ductile—brittle transition temperature. The stronger the locking, the higher the transition temperature.

539.2

20812 ON DISLOCATION FORMATION BY VACANCY CONDENSATION. G.Schoeck and W.A.Tiller.
Phil Mag. (Eighth Ser.), Vol. 5, 43-63 (Jan., 1960).

The mechanism of dislocation loop formation by vacancy condensation is examined in a quantitative manner. The critical vacancy supersaturation necessary for the growth of the loops and the climb rate of the dislocations are determined. It is shown that the mechanism proposed for lineage formation based upon loop growth (Frank, 1956) is inapplicable. The number of dislocation loops produced by collapsing vacancy disks is calculated as a function of the cooling rate, cooling range and dislocation density existing in the crystal before cooling.

539.2

20813 THE DISLOCATION DISTRIBUTION, FLOW STRESS, AND STORED ENERGY IN COLD-WORKED POLYCRYSTALLINE SILVER. J.E.Bailey and P.B.Hirsch.
Phil. Mag. (Eighth Ser.), Vol. 5, 485-97 (May, 1960).

Distribution and densities of dislocations, determined by electron transmission microscopy, flow stress and stored energy measurements (by microcalorimetry) on cold-worked polycrystalline silver are correlated with each other. The dislocations are arranged in dense networks forming the boundaries of an otherwise relatively dislocation-free cell structure. The flow stress is explained quantitatively in terms of the forest intersection mechanism at the boundaries. The stored energy after recovery is of the same order as the total self-energy of the dislocation arrangement, so that the long-range stresses must be largely relaxed. The considerable energy release during the recovery stage produces no observable change in dislocation distribution. This recovery stage is thought to be due to the relief of long-range stresses or to the removal of point defects. While the values of flow stress and stored energy can be accounted for in terms of the observed non-uniform distribution of dislocations (cell structure), they are not compatible with each other on a model based on a uniform distribution of pile-ups; nor are pile-ups observed on the electron micrographs.

539.2

20814 ON DISLOCATIONS FORMED BY THE COLLAPSE OF VACANCY DISCS. C.Elbaum.
Phil. Mag. (Eighth Ser.), Vol. 5, 669-74 (July, 1960).

The formation of dislocations by the collapsing vacancy disk mechanism is examined for aluminium, copper, silicon and germanium. It is shown that this mechanism can be important in the case of metals. In the case of silicon and germanium dislocation loops produced by the above mechanism, during usual crystal growth from the melt, will not reach sizes detectable by means of the optical microscope.

539.2

20815 DISLOCATION NETS IN BISMUTH AND ANTIMONY TELLURIDES. P.Delavignette and S.Amelinckx.
Phil. Mag. (Eighth Ser.), Vol. 5, 729-44 (July, 1960).

The electron microscopic examination of thin foils of bismuth and antimony telluride, prepared by repeated cleavage, reveals the presence of extended dislocation patterns. Since the c-plane is simultaneously glide and cleavage plane, the dislocation arrangements are preferentially situated in the plane of observation. This is a considerable advantage if one wishes to study the configurations due to glide, since one might hope that the typical thin foil behaviour would not apply to the glide planes parallel to the foil. Sets of concentric dislocation lines are often observed, ut they invariably originate in some invisible source, outside the crystal. In the c-plane very extended nets are often observed. e multiplication of dislocations and the resulting formation of netw as well as the elimination of dislocations are observed whilst in progress. The latter phenomenon is due to a combination of glid and climb. Some contrast effects are also mentioned.

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20816 DISLOCATIONS WITH BURGERS VECTORS OF a⟨100⟩ IN CRYSTALS OF SILVER BROMIDE. J.T.Bartlett and J.W.Mitchell.
Phil. Mag. (Eighth Ser.), Vol. 5, 799-802 (Aug., 1960).

Experimental observations of the combination of two disloca with Burgers vectors of $\frac{1}{2}$a⟨110⟩ at right angles to form a single dislocation with a Burgers vector of a⟨100⟩ are described. It is believed that this is the first occasion upon which the interaction has been definitely established for dislocations on glide planes.

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20817 CHARGED DISLOCATIONS IN LITHIUM FLUORIDE. R.L.Sproull.
Phil. Mag. (Eighth Ser.), Vol. 5, 815-31 (Aug., 1960).

The application of strong electrostatic fields to bent LiF crystals produced small motions (0.1 to 6 A) of the bends which were analysed in terms of the motion of charged dislocations. The cha on the dislocation core was positive and of the order of 10^{-4} to 10^{-3} e.s.u./cm, and it presumably arose from the inequality of the free energies of formation of positive ion and negative ion vacanci Estimates of the electrostatic contribution to the critical shear strength based on these values of charge substantiate the suggesti by Eshelby et al. (Abstr. 1322 of 1958) that much of this strength be electrostatic in origin.

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20818 ETCH PITS CORRESPONDING TO DISLOCATIONS IN FERROELECTRIC GUANIDINIUM ALUMINUM SULFATE HEXAHYDRATE [GASH]. T.Nakamura.
J. Phys. Soc. Japan, Vol. 14, No. 8, 1022-9 (Aug., 1959).

The cleavage surface of a GASH crystal was etched with a mi ture of water and ethyl alcohol, followed by rinsing in benzene. Identical etch pits were observed on matching cleavage faces. Th density of the pits is about 10^4 cm^{-2}. Mechanical shock produces etch pits. Successive etching causes growth of pits at the unchang locations. These facts lead to the conclusion that the pits must correspond to dislocations. Patterns of etch pits on the upper and lower cleaved faces of the crystal indicated that the dislocation penetrates the crystal to several hundred microns. Pair arrangements and linear arrays of etch pits were observed. Etch pits, of which the deepest points differ from the centres of triangles, correspond to dislocations not perpendicular to the cleavage surfa

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20819 DISLOCATION ETCH PITS IN ZINC CRYSTALS. J.George.
Phil. Mag. (Eighth Ser.), Vol. 4, 1142-4 (Oct., 1959).

Star-shaped terraced etch pits at the sites of dislocations we produced on the (0001) plane of crystals of vapour grown zinc, usi Superoxol etch. The same etch pattern is also observed on the (0 basal facets of crystals grown by the droplet method. Closely spa etch pits suggestive of low-angle tilt boundaries are also observe Evidence is also presented of spiral growth mechanism from a Frank—Read source.

539

20820 ON THE CONTRAST OF THE ELECTRON MICROSCOPIC IMAGE DUE TO AN EDGE DISLOCATION. H.Hashimoto and M.Mannami.
Acta Cryst., Vol. 13, Pt 4, 363-4 (April, 1960).

Approximate treatment by dynamical theory of electron diffra

J.Ad

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20821 ELECTRONMICROSCOPIC OBSERVATIONS OF THE CLEAVAGE PLANE OF KCl CRYSTAL. THE DEFO ATION ZONE. T.Tomiki.
J. Phys. Soc. Japan, Vol. 14, No. 7, 924-31 (July, 1959).

The deformation zone of KCl single crystal decorated with potassium colloid particles is investigated with an electron micr sc e using a replica technique. The deformation zone is formed in endently on the imperfections contained originally in the crystal. Tl slip lines near the deformation zone observed with an optical m oscope consisted of a number of fine slip lamellae. The thickne D of the slip lamella, the slip distance s and the height h of the sl step were estimated as D = 720 A, s = 270 A and h = 240 A for th adjacent slip lines. It is suggested that several hundreds of sc w type dislocations are attached to every new cleavage step at th leformation zone. Attempts are made to explain the mechanism by hich new cleavage steps are formed at the deformation zone.

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0822 ELECTRON MICROSCOPE OBSERVATIONS ON THE ANNEALING PROCESSES OCCURRING IN COLD-W KED SILVER. J.E.Bailey.

P . Mag. (Eighth Ser.), Vol. 5, 833-42 (Aug., 1960).

Electron microscope observations on the dislocation structure o old-worked polycrystalline silver and on the processes occurring d ng annealing are described. In silver deformed 25% in tension tl dislocations are arranged in a cell structure and the stored e gy is released in two stages, a recovery stage followed by r ystallization. During the recovery stage there is no observable c ge in the dislocation distribution but there is a possibility of s ll-scale dislocation rearrangements within the cell boundaries. R rystallization occurs by the migration of the grain boundaries o inally present in the metal and this process is discussed in s e detail. Observations made on heavily rolled silver annealed e er inside the electron microscope on a heating stage or outside t microscope are also described.

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20823 ELECTRON MICROSCOPE OBSERVATIONS OF DEFORMED MAGNESIUM OXIDE.

'ashburn, G.W.Groves, A.Kelly and G.K.Williamson.
l. Mag. (Eighth Ser.), Vol. 5, 991-9 (Oct., 1960).

Observations were made by electron transmission microscopy hin flakes of deformed magnesium oxide. The ease of cross slip screw dislocations in this material was directly verified. Cross led to the formation of many markedly elongated prismatic loops dislocation. These were observed profusely within slip bands, duced at room temperature. They were unstable at higher peratures and broke up into numbers of smaller prismatic loops. om these observations a mechanism for the widening of slip bands, served under the optical microscope, was proposed. Certain location interactions were observed and analysed and preliminary servations made of slip band intersections.

539.2 : 539.27

ELECTRON MICROSCOPY OF DISLOCATIONS. See str. 16367

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20824 OBSERVATIONS OF DISLOCATIONS AND PRECIPITATES IN ALUMINIUM ALLOYS. G.Thomas.

il. Mag. (Eighth Ser.), Vol. 4, 606-11 (May, 1959).

Electron transmission micrographs of quenched aluminium loys show that the specimens contain many complex dislocations d large dislocation loops with diameters up to 2000 A. These slocations could not be moved by heating the foils in the electron am and their immobility is thought to be due to substitutional mospheres of solute atoms which form at, and lock, the discations by vacancy-aided diffusion. This has been confirmed ageing the foils, which causes precipitation to occur on the discations. These precipitates also lock the dislocations by a pinning tion because stresses of the order of $\mu/50$ are required to free e dislocations. The observations are discussed in relation to the rdening effect of quenching and of precipitation after ageing. The ovement of glissile dislocations in quenched alloys is typical of a aterial of high stacking fault energy, i.e. there are no partial discations and cross slip is frequently observed.

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20825 THE GROWTH OF PRECIPITATES.

R.G.Baker, D.G.Brandon and J.Nutting.

il. Mag (Eighth Ser.), Vol. 4, 1339-45 (Dec., 1959).

During the growth of coherent precipitates, stresses are nerated because the lattice dimensions of the precipitate differ om those of the matrix. When the strain energy is large enough will be relieved by the precipitate losing continuity with the atrix, i.e. becoming non-coherent. It is suggested that this will cur by the formation or annihilation of close-packed planes of atoms by the aggregation of either interstitials or vacancies. This leads to the formation of dislocations at the interface. The exact nature of the process in a given precipitate will depend upon both the shear stresses and hydrostatic stresses acting on the close-packed planes and upon the stacking-fault energy of the precipitate. The problem is given a general treatment for the case of precipitation in a f.c.c. matrix.

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20826 PRECIPITATION IN SILICON CRYSTALS CONTAINING ALUMINUM.

R.Bullough, R.C.Newman, J.Wakefield and J.B.Willis.
J. appl. Phys., Vol. 31, No. 4, 707-14 (April, 1960).

Silicon crystals containing aluminium have been annealed at various temperatures within the range 700° to 1350°C, particular emphasis being given to the range 1200° to 1300°C. Precipitation, which occurs during the heat treatment in the bulk crystal and on various structural defects, has been detected by transmission optical microscopy. A lowering of the aluminium concentration in the neighbourhood of the precipitate particles after heating at 1250°C has been revealed at the surface by a novel technique involving the etching of crystals which also contain phosphorus, where internal cylindrical and planar p-n junctions are formed round individual dislocations and grain boundaries, respectively. At this temperature, no precipitation is observed on dislocations in plastically deformed crystals. The precipitation of aluminium is interpreted in terms of a chemical reaction involving the coprecipitation of oxygen and possibly carbon.

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20827 THE BEHAVIOUR OF HELIUM ATOMS INJECTED INTO BERYLLIUM. R.S.Barnes and G.B.Redding.

Reactor Science, Vol. 10, No. 1-2, 32-5 (July, 1959).

Disks of extruded and cast beryllium have been injected with helium by bombardment with alpha-particles in a cyclotron. Microscopic observation of the region at the end of the alpha-particle track shows that the helium contained there precipitates as gas bubbles only if the beryllium is heated to about 800°C, when the grain boundaries act as sources of the vacancies necessary for the precipitation. Further heating causes the bubbles, which are initially about 4×10^{-6} cm in diameter, to enlarge and to reduce in number; this is accelerated at the grain boundaries. The large difference in grain size between the extruded and cast beryllium permits a lower temperature of precipitation and more rapid coarsening in the former.

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20828 EXPERIMENTAL EVIDENCE OF BOUNDARY MIGRATION. A.Ferro, C.Sari and G.Venturello.

Acta metallurgica, Vol. 7, No. 6, 429-31 (June, 1959).

Atmospheres slightly oxidizing towards silicon (pH_2O/pH_2 between 1.3×10^{-5} and 4.3×10^{-5}) have been found to be suitable for observing grain boundary migration in Fe—Si alloys. The recrystallized regions are less susceptible to oxidation than both the grain boundary and unrecrystallized regions and as a result displacement of the boundary due to small variations in temperature or other causes is marked by an oxide trace. A complete record of the boundary movement is thus obtained. Also when the hydrogen annealing temperature is very high the grain boundary positions are also revealed by the deformation of the metal surface close to the boundary itself. As the boundary migrates from one position to another the trace of the former position disappears very slowly and is visible even after a long time. A.E.Kay

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20829 DISCUSSION OF "EXPERIMENTAL EVIDENCE OF BOUNDARY MIGRATION". C.G.Dunn and J.L.Walter.

Acta metallurgica, Vol. 8, No. 1, 60-3 (Jan., 1960).

Ferro et al. (see preceding abstract) have suggested that recrystallized regions (areas swept by grain boundaries) were less susceptible to oxidation in silicon iron than unrecrystallized regions on the basis of a correlation between oxide patterns and grain boundary migration in this material. A different interpretation of this correlation is presented on the basis of the several oxide patterns illustrated. It is concluded that both thermal faceting and thermal grooving are important factors in the formation of the oxide patterns. W.Bardsley

539.2 : 621.382

20830 IMPURITIES IN GERMANIUM. W.C.Dunlap, Jr.

Progress in semiconductors, Vol. 2 (London: Heywood. 1957) p. 165-209.

The effects of various impurity elements in germanium, and the properties of germanium characterized by the doping element are reviewed in detail. Properties considered are the segregation coefficient, solubility, the diffusion coefficient, electrical activity and ionization energy, impurity scattering, photoconductivity, optical absorption, recombination and trapping, the influence of impurities upon intrinsic properties, and "interference" effects of one impurity upon another. The methods of impurity analysis surveyed are radioactive tracers, neutron activation, mass spectrometry, chemical analysis, and optical spectrography. 98 references. J.B.Birks

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20831

DEFECTS IN IONIC CRYSTALS. II. AN ANALYSIS OF F AND V_1 CENTERS.

T.Kurosawa.

J. Phys. Soc. Japan, Vol. 14, No. 6, 741-6 (June, 1959).

For Pt I, see Abstr. 8804 of 1959. The deformation of the lattice around F and V_1 (the Seitz' model) centres in alkali halides is determined from experimental data on the difference between the two ionization energies (optical and thermal) of these centres. The method developed in Pt I was used in the determination. It was found that the lattice deformation was rather small in the case of the F centres, but very large in the case of the V_1 centres.

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ON THE ELECTRONIC STRUCTURE OF THE U_2-CENTER IN KCl CRYSTALS. I.

H.Mimura and Y.Uemura.

J. Phys. Soc. Japan, Vol. 14, No. 8, 1011-22 (Aug., 1959).

The electronic structure is studied using the point-ion lattice model. The wave-function, which is obtained for the ground state of the U_2 centre by considering the effects of various kinds of interactions, is used to analyse the e.s.r. data. The 1s wave-function of the free hydrogen orthogonalized to the core orbitals of the surrounding ions gives an interpretation of the e.s.r. in the order of magnitude, but there still remain some discrepancies between the calculated and the observed values. The physical origins of these discrepancies are considered. The large zero point vibration of the U_2-centre suggests that the width of the e.s.r. absorption curve is broadened about 20% by the vibration. The effects of polarization, of crystalline field and the optical absorption are considered briefly by assuming the point ion and dipole approximation.

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20833

F—M CONVERSION IN ADDITIVELY COLORED KCl CRYSTALS.

M.Hirai.

J. Phys. Soc. Japan, Vol. 14, No. 10, 1400-7 (Oct., 1959).

The photochemical reaction of F → M conversion in an additively coloured KCl crystal was investigated as a function of the concentration of F-centres, under the condition that differently coloured crystals absorb equal number of incident photons. The process of F-band bleaching is separated into two steps: fast and slow bleaching. During earlier stages of F-light irradiation the F-band displayed fast bleaching and its amount in each crystal was equal and independent of the F-centre concentration, but the growth rate of the M-band was proportional to the square root of the concentration of F-centres. An absorption band, which may be Petroff's A-band, was induced on the red side of the F-band, but the appearance of this band was dominant in the crystal lightly coloured. These results show that the mechanism of the optical F → M conversion depends on the F-centre concentration, and that the M-centre is converted from the F-centre through certain intermediate states. In the case of the F-centres converted from U-centres, the growth of the M-band was small as compared with that of additively coloured crystals containing only F-centres, and the growth of the A-band was also negligibly small.

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ON THE PREFERENTIAL BLEACHING OF THE M BAND IN KCl CRYSTAL WITH POLARIZED LIGHT.

T.Ishii, T.Tomiki and M.Ueta.

J. Phys. Soc. Japan, Vol. 14, No. 10, 1415-21 (Oct., 1959).

The temperature dependence of the dichroic properties of the M-centre in KCl crystal was investigated. At temperatures above 60°C, thermal reorientation of the M-centre in the ground state occurs. The measured value of the activation energy was 1.0 eV. It was suggested that vacancy clusters may trap free electrons to form new M-centres in the course of the bleaching of the M-band and this process may be responsible for the temperature dependence of dichroism of the M-band.

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QUENCHING EFFECT IN KCl CRYSTALS.

M.Sakamoto.

J. Phys. Soc. Japan, Vol. 14, No. 11, 1506-12 (Nov., 1959).

Effects of thermal quenching on KCl crystals were studied i both clear and coloured specimens. These were subjected to twc types of quenching, down- and up-quenching. The etching method was carried out to examine generated dislocations and the photo-elastic method was used to see the distribution of the residual stresses. The results of the experiments are as follows: (1) generated dislocations, distributing from the crystal surface tow the interior, were perceived; (2) they ranged over a lunar area along the edges in the cross-section of the specimen; (3) the rang in which the residual stresses exist, has also the same lunar form along the edges, and therefore the residual stresses are considered as resulting from the thermal generation of slips. Th experimental facts can be explained on the basis of thermal stres

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COLORATION OF PURE AND DOPED CALCIUM FLU-RIDE CRYSTALS AT 20°C AND -190°C.

W.J.Scouler and A.Smakula.

Phys. Rev., Vol. 120, No. 4, 1154-61 (Nov. 15, 1960).

Coloration of pure CaF_2 crystals with 2.5 MeV electrons at room temperature results in bands at 580, 400, 335, and 225 mμ. In YF_3-doped crystals the bands are in the same spectral position as in pure crystals. They are, however, enhanced and their intensity ratios are significantly changed, the 400 mμ band being predominant. NaF-doped crystals show an even more drastic change coloration at room temperature produces bands at 605, 385, and 330 mμ and is deeper than in either pure or YF_3-doped crystals. Since the 400 mμ band is strongly enhanced by YF_3 addition which forms F^- interstitials, it is correlated to neutral fluorine atoms in interstitial positions. Similarly, the 605 mμ band in crystals doped with NaF, which creates F^- vacancies, is correlated to electrons trapped in F^- ion vacancies (F centres). The enhancement of the 385 mμ band by NaF is explained by the reduction of the activation energy required for formation of interstitials and vacancies. Of several possible correlations the 330 mμ band is probably connected with a hole trapped in a Ca^{2+} vacancy and that at 225 mμ with an electron trapped by a Ca^{2+} interstitial. The ban at 440 and 200 mμ which appear in NaF-doped crystals only must connected with Na ions. Coloration at -190°C produces strong changes in the absorption spectrum. In pure and YF_3-doped cryst bands appear at 550, 320, and 270 mμ while in NaF-doped crystals bands are formed at 440, 390, 315, and 200 mμ in addition to the 550 mμ band. The primary process of coloration at low temperature cannot differ from that at room temperature but the secondar processes are strongly influenced by temperature.

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COLOR CENTERS IN ALKALINE EARTH FLUORIDES

D.Messner and A.Smakula.

Phys. Rev., Vol. 120, No. 4, 1162-6 (Nov. 15, 1960).

Single crystals of CaF_2, SrF_2 and BaF_2 were coloured by X-ray (150 kV) and high-energy electrons (2.5 MeV). Five colour-centre bands in CaF_2 and SrF_2 and nine in BaF_2 were observed in the spectral region between 0.175 and 0.8 μ. At room temperature the bands in CaF are well resolved, while those in SrF_2 and BaF_2 overlap. At -190° and -255°C the bands sharpen but generally do not shift, except th 580 mμ band in CaF_2 which shifts toward longer wavelengths. Photochemical bleaching of the strongest band shows a certain influen on the others. Three bands could be correlated to the Mollwo relation with the exponent 3.85. A possible correlation of the absorpti bands to certain models is discussed.

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20838

DIFFUSION OF F CENTERS INTO POTASSIUM CHLORIDE SINGLE CRYSTALS.

H.Mizuno and M.Inoue.

Phys. Rev., Vol. 120, No. 4, 1226-9 (Nov. 15, 1960).

The diffusion of F-centres into potassium chloride crystals during an additive colouring process was measured at various tem peratures. A diffusion process which can be explained by a simpl theory of volume diffusion seems to be predominant at higher tem peratures. At lower temperatures, however, the occurrence of a disordered interfacial diffusion, with an F-centre concentration decreasing exponentially with the first power of penetration depth, is confirmed.

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ISOTOPE EFFECT IN VACANCY DIFFUSION.

K.Tharmalingam and A.B.Lidiard.

Pt Mag. (Eighth Ser.), Vol. 4, 899-906 (Aug., 1959).

Γhe experimental determination of correlation factors in dif sion in crystals is of great value in elucidating diffusion m anisms. Schoen (Abstr. 847 of 1959) has proposed a method ap cable to both metals and non-metals based on measurements of th elative diffusion rates of two different isotopes of the diffusing el ent. His analysis was based on an equation derived from an ap oximate expression for the correlation factor for vacancy di sion. It is shown in the present paper that his basic equation is act for all systems having at least two-fold rotational symmetry al t the vacancy-solute jump directions.

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THE INFLUENCE OF SOLUTES ON SELF-DIFFUSION IN METALS.

A.B.Lidiard.

P . Mag.(Eighth Ser.), Vol. 5, 1171-80 (Nov., 1960).

A statistical theory of the effect of solutes on solvent-diffusion i ilute alloys is given. It is based on the vacancy model used p viously by Hoffman, Turnbull and Hart and includes a qualitative c sideration of correlation effects. Two limiting cases are c sidered: (i) in which the vacancy jump frequencies are not g atly changed by the solute atoms ("weak perturbation" limit), (in which the vacancies attach themselves strongly to solute a ns and where the jump frequencies may be greatly different (ght-binding" limit). In both cases it is shown how experimental d ı on solute-enhanced diffusion of solvent atoms combined with k wledge of solute tracer diffusion rates may be used to deduce ' rrelation factors" for solute diffusion. Analysis of existing data c lilute Ag alloys yields similar correlation factors whichever of t two limiting equations we use. The results are not consistent v ı the absence of isotope effects in Cd and In diffusion in Ag: t may indicate that the model is inadequate for the discussion of s ıte—enhanced diffusion. Further experimental work, particularly isotope effects, is called for.

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DIFFUSION OF BORON IN GRAPHITE.

P.S.Kislȳi and G.V.Samsonov.

. tverdogo Tela, Vol. 2, No. 8, 1729-32 (Aug., 1960).
Russian.

The diffusion produced solid solutions. The diffusion coefficient D = 3.02 exp(−28 625/T) cm²/sec, where T is the absolute ıperature.

A.Tybulewicz

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20842

DIFFUSION OF Ag^+, Cl^-, AND Cd^{++} IN SILVER CHLORIDE SINGLE CRYSTALS.

.Reade and D.S.Martin, Jr.

appl. Phys., Vol. 31, No. 11, 1965-8 (Nov., 1960).

The diffusion rates of silver, chlorine, and cadmium ions in gle crystals of silver chloride have been investigated by means a modification of the surface counting method. The diffusion efficient of the silver ion from 200° to 400°C was represented by equation $D = 9.36 \exp(-1.101\ \mathrm{eV}/kT)\ \mathrm{cm}^2/\mathrm{sec}$. Estimates of oride ion activation energies gave a value of 1.57 eV between)° and 400°C, and a value of 0.37 eV below 280°C. The silver and oride ion diffusion data have been compared with results of rkers who used sectioning methods. The diffusion coefficient the cadmium ion may be expressed by the equation
$= 32.8 \exp(-1.36\ \mathrm{eV}/kT)\ \mathrm{cm}^2/\mathrm{sec} + 2.35 \times 10^{-5} \exp(-0.56/kT)\ \mathrm{cm}^2\ \mathrm{sec}$.

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A POSSIBLE DETERMINATION OF THE ACTIVATION ENERGY FOR SELF-DIFFUSION IN ALUMINIUM.

Federighi.

ıil. Mag. (Eighth Ser.), Vol. 4, 502-10 (April, 1959).

A more detailed study of the so-called stage II of the annealing t of the quenched-in resistivity in 99.995% aluminium (Abstr. 7515 1959) was carried out. The process is found to be a single acti- ted one, the activation energy being $Q = 1.33 \pm 0.05$ eV; the alytical shape of the isothermal curves is given by $f = 1 - (t/\tau)^m$ here $m \sim 0.55$ and $\tau = 2.6 \times 10^{-8} \exp(Q/kt)$ sec. Several con- derations leave little doubt that Q is to be identified with the tivation energy for self-diffusion in aluminium, although the ture of the defects and the mechanism of annealing out are yet t clearly understood.

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20844

THE ATOMIC DIFFUSION OF CHROMIUM IN THE TITANIUM—CHROMIUM SYSTEM.

A.J.Mortlock and D.H.Tomlin.

Phil. Mag. (Eighth Ser.), Vol. 4, 628-43 (May, 1959).

Diffusion rates of chromium in the b.c.c. phase of the titanium—chromium system were measured by an autoradiographic tracer technique using the radioactive isotope Cr^{51}. Two alloys, Ti + 10% Cr and Ti + 18% Cr (by weight), in addition to two grades of Ti metal, "iodide" and "commercial", were used as solvents so that tracer diffusion coefficients at essentially 0, 10 and 18% Cr concentration were measured, over the temperature range 900° to 1200°C. The results are expressed in equations of the form $D = D_0 \exp(-Q/RT)$. The most significant feature is that the activation energy Q for tracer diffusion at zero solute concentration is very much lower than that expected for self-diffusion in pure Ti. An extension of the Johnson model of solute diffusion in f.c.c. metals to the b.c.c. lattice is proposed as an explanation of this divergence.

539.2

20845

CRYSTAL FINE STRUCTURE, CONDUCTIVITY AND CATION SELF-DIFFUSION IN SODIUM CHLORIDE.

I.M.Hoodless and S.J.Thomson.

Phil. Mag. (Eighth Ser.), Vol. 4, 1131-41 (Oct., 1959).

The Na^+ self-diffusion and ionic conductivity were measured in single crystal plates of sodium chloride in the low temperature range. These plates, which were taken from the same sodium chloride boule, were subjected to either chilling in liquid nitrogen or annealing at 600°-620°C prior to the measurements. Both treatments produced increases in the ionic conductivity while the self-diffusion was relatively unchanged. The results are explained in terms of space charge and impurity effects.

539.2

20846

THE ATOMIC DIFFUSION OF PLATINUM IN GOLD.

A.J.Mortlock, A.H.Rowe and A.D.LeClaire.

Phil. Mag. (Eighth Ser.), Vol. 5, 803-14 (Aug., 1960).

Measurements are reported of the diffusion of platinum at tracer concentrations in gold over the temperature range from 800°C to close to the melting point of gold. Above about 900°C, the results can be fitted to the following equation:

$$D = (7.6 {}^{+4.7}_{-2.9}) \exp[-(60\,900 \pm 1200)/RT]\ \mathrm{cm}^2/\mathrm{sec}.$$

The magnitude of the observed activation energy relative to that corresponding to self-diffusion in gold is in qualitative agreement with current theories. Below about 900°C, the observed diffusion coefficients appear to be enhanced relative to those expected by extrapolation from higher temperatures; possible explanations of this effect are discussed.

539.2

20847

CUPROUS HALIDE FILMS ON ALKALI HALIDE CRYSTALS.

L.M.Kraemer.

J. chem. Phys., Vol. 33, No. 4, 991-3 (Oct., 1960).

Films of cuprous halides were formed by evaporation and condensation in a vacuum on to substrates of alkali halide crystals at room temperature. They were annealed for 15 min periods at temperatures between 60° and 150°C. Optical absorption spectra indicate that the annealing causes diffusion of CuCl and CuBr into KCl and KBr, but not into KI or NaCl, and of CuI into RbI, but not into KCl, KBr, KI or NaCl. An interstitial mechanism for diffusion is consistent with the data but is not sufficient to account for the behaviour of CuI.

539.2

20848

PERMEATION OF HYDROGEN THROUGH METALS.

R.Ash and R.M.Barrer.

Phil. Mag. (Eighth Ser.), Vol. 4, 1197-1206 (Nov., 1959).

The theory of permeation of hydrogen through certain transition metals is further developed. It is shown that this theory, in which certain slow phase-boundary processes couple with diffusion to produce the permeation phenomena, can in rather simple ways predict the observed behaviour. In particular, "threshold pressures" for permeation can be understood; and also permeation velocities which depend on the ingoing pressure p_1, according to p_1^n where $0 \leq n \leq 1$, and upon membrane thickness l according to l^m where $-1 \leq m \leq 0$.

539.2

20849 ADVANCES IN RADIATION EFFECTS.

D.S.Billington, D.O.Leeser, J.W.Clark, T.D.Hanscome, J.G.Carroll, R.O.Belt and E.L.Barkhard.

Nucleonics, Vol. 18, No. 9, 63-86 (Sept., 1960).

A review of present data and theory of the effects of nuclear radiation on metals, organics and electronic components. Observed effects depend markedly on the effects of minor impurities and the environment at the time of irradiation. In metals the presence of B, Be or Li causes gas production as a result of nuclear reactions and swelling or cracking may follow. The properties of metals and alloys are also affected by the production by radiation of additional vacancies. Experimental results on the changes in strength and ductility are tabulated. Electronic components depending on semiconductors may be greatly affected by radiation, but capacitors and resistors are also altered mainly as a result of changes in insulation resistance. Organic materials are divided into elastomers, plastics, lubricants and reactor coolants and the qualitative effects of radiation discussed. An extensive bibliography is included.

R.D.Smith

539.2 : 621.382

20850 RADIATION EFFECTS IN SEMICONDUCTORS.

J.H.Crawford, Jr and J.W.Cleland.

Progress in semiconductors, Vol. 2 (London: Heywood. 1957) p. 67-107.

Summarizes the effects of fast-particle bombardment on a number of semiconducting systems. Topics discussed include the nature of radiation-produced defects, defects in diamond-lattice semiconductors, experimental indications of defect states, the annealing of bombardment-produced defects, and the effects on various properties — mobility, optical absorption, spectral dependence of photoconductivity, minority carrier phenomena and magnetic susceptibility. 68 references.

J.B.Birks

539.2

20851 RECOVERY OF LATTICE EXPANSION OF IRRADIATED MOLYBDENUM.

D.L.Gray.

Acta metallurgica, Vol. 7, No. 6, 431-2 (June, 1959).

Commercial molybdenum containing some residual cold work was given irradiations of 6.5×10^{16} to 2.3×10^{19} nvt in a fast neutron flux at temperatures between 30° and 40°C. The dimensions of the b.c.c. lattice are increased by irradiation and the increase becomes smaller at the higher irradiation levels. Heat treatment showed that the recovery could be separated into three regions where different mechanisms of defect removal operated. These processes occurred at 100-200°C, 400°C and 500-800°C. Examination of the recovery data obtained at temperatures between 100° and 170°C indicated that a conventional plot of log(time) versus T^{-1} for any given amount of lattice recovery would not yield a unique value for the activation energy; in fact the energy calculated from such a plot would increase as the recovery progressed.

A.E.Kay

539.2

20852 RADIATIONAL DISTURBANCES IN CRYSTALS.

L.S.Smirnov.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1669-70 (July, 1960). In Russian.

It is suggested that high energy particles may produce defects by local melting in solids which expand at the melting point. Solids which contract at the melting point are also briefly considered.

R.F.S.Hearmon

539.2

20853 THE DAMAGE AND RECOVERY OF NEUTRON IRRADIATED TUNGSTEN.

M.W.Thompson.

Phil. Mag. (Eighth Ser.), Vol. 5, 278-96 (March, 1960).

Residual electrical resistivity was used as an index of the damage present in tungsten irradiated in a nuclear reactor at 4° and 77°K. A comparison was made between four different types of specimen prepared from cold-drawn wire respectively annealed before irradiation at 2000°, 1500°, 800°C and not at all. A fifth type of specimen was prepared from wire in a different state of purity. Four stages of recovery were identified, the first occurring below −170°C, the second between −170° and 350°C with an activation energy rising from 0.25 to 1.7 eV, the third between 350° and 450°C with a single activation energy of 1.7 eV and the fourth above 450°C. Second-stage recovery was enhanced by the presence of cold-work, affected by impurities and in well-annealed samples after light irradiations it was suppressed. A comparison of recovery with that in other metals leads to the conclusion that vacancies in tungsten migrate at 400°C with an activation energy of 1.7 eV. The general suggestion is advanced that vacancy migration occurs in metals at a temperature approximately 20% of the absolute melt point T_m°K, with an activation energy roughly $5 \times 10^{-4}\ T_m$ eV. Recovery in tungsten above −170°C is attributed to the release o interstitials from traps associated with impurity atoms and dislocation lines. The free interstitial is assumed to become mobil below −170°C. The resistance versus dose curve for cold-worke tungsten shows acceleration and this is considered as evidence f the action of spikes on the unstable arrays of vacancies produced by deformation. A quantitative theory of damage and recovery developed from the above model predicts the observed behaviour the five types of tungsten specimen.

53

20854 THE ANNEALING OF ELECTRON IRRADIATION DAMAGE IN GRAPHITE.

W.N.Reynolds and P.R.Go

Phil. Mag. (Eighth Ser.), Vol. 5, 1049-58 (Oct., 1960).

Samples of pure artificial graphite were irradiated with electrons at 79°K, and a study made of the annealing characteris of the changes in electrical conductivity, Hall effect and magnetoresistance. All three quantities show an anomalous annealing ra below 120°K, and a simplified band theory calculation indicates th the concentration of both electrons and positive holes increase during irradiation and also in the anomalous annealing range.

539.2 : 539

20855 RADIOACTIVE PREPARATION OF DEFECTS IN SOL

J.Lambe.

Phys. Rev., Vol. 120, No. 4, 1208-11 (Nov. 15, 1960).

An experimental study was made of the use of radioactive materials in preparing defects in solids. Paramagnetic resonance was used to study such defects. The systems studied utilized tritium and Kr^{85}. Solid tritium was studied at 4.2°K. It was found that atomic tritium was formed and showed a characteristic hyper fine splitting of 543 G. Kr^{85} was also studied at 4.2°K. This shou yield atomic rubidium but no paramagnetic resonance characteris of this atom was found.

539

20856 DYNAMICS OF RADIATION DAMAGE.

J.B.Gibson, A.N.Goland, M.Milgram and G.H.Vineyard

Phys. Rev., Vol. 120, No. 4, 1229-53 (Nov. 15, 1960).

Radiation damage events at low and moderate energies (up to 400 eV) are studied by machine calculations in a model representi copper. Orbits of knock-on atoms are found and the resulting dam aged configurations are observed to consist of interstitials and vacancies. Thresholds for producing permanently displaced atom (i.e. interstitials) are about 25 eV in the 100 direction, 25 to 30 in the $\langle 110 \rangle$ direction, and around 85 eV in the $\langle 111 \rangle$ direction. Collision chains in the $\langle 100 \rangle$ and $\langle 110 \rangle$ directions are prominent; low energies the chains focus, at higher energies they defocus. Above threshold, the chains transport matter, as well as energy, produce an interstitial at a distance. The range of $\langle 110 \rangle$ chains is studied in detail. Localized vibrational modes associated with int stitials, agitations qualitatively like thermal spikes, ring annealin processes, and a higher energy process somewhat like a displacement spike have been observed. Replacements have been found to very numerous. The configurations of various static defects have also been studied in this model. The interstitial is found to reside a "split" configuration, sharing a lattice site with another atom. crowdion is found not to be stable, and Frenkel pairs are stable on beyond minimum separations, which are found to be very much dependent on orientation.

539

20857 SMALL-ANGLE X-RAY SCATTERING BY PILE-IRRADIATED GRAPHITE.

W.T.Eeles.

Nature (London), Vol. 188, 287-9 (Oct. 22, 1960).

Experimental details and results concerning several specime ($5\text{-}17 \times 10^{20}$ n.v.t. at about 150°C) in comparison with unirradiat ones were given. The significance of preferred orientation and o clustering of interstitials for the height of the diffuse peak was shown with two figures. Scattering centres and vacancies were discussed. One specimen irradiated at 300°C showed no increase in small-angle scattering.

H.E.Schm

53

20858 SMALL-ANGLE SCATTERING OF X-RAYS BY A DEUTERON-IRRADIATED GERMANIUM CRYSTAL.

U.Gonser and F.E.Fujita.

Physica, Vol. 24, Supplement, S177-S178 (Sept., 1958).

ow Temperature Physics Conference (see Abstr. 7017 of 1960). note, substantially as follows: Recent radiation damage tigations focus more and more attention on the question of the ence and nature of spikes. It was suggested that in materials germanium where a high temperature phase exists which is more than the low temperature phase the high temperature phase is iced by the high pressure which a thermal spike exerts on the ounding matrix. A small-angle X-ray scattering technique was ed to thin Ge specimens irradiated at liquid nitrogen tempera- with 12 MeV deuterons from the University of Illinois cyclo- According to Guinier's formula small particles which are sup- d to be the spike regions are found to be about 30 A in radius. aling produces a pronounced change in X-ray scattering: the sity decreased to 1/5 of the original value. One may conclude this phenomenon is due to the retransformation to the original guration.

539.2 : 539.1.07

DAMAGE IN MICA EXPOSED TO FISSION FRAGMENTS: CTRON MICROSCOPE STUDY. See Abstr. 19979

ELECTRICAL PROPERTIES OF SOLIDS

(Superconductivity is included under Low-Temperature Physics)

539.2 : 537.3

0859 ON THE SCREENING OF IMPURITY POTENTIAL BY CONDUCTION ELECTRONS. N.Takimoto.

hys. Soc. Japan, Vol. 14, No. 9, 1142-58 (Sept., 1959).

A detailed investigation is made of the self-consistent impurity ential in a charge cloud of conduction electrons. It is shown that Thomas—Fermi method can be used so as to include a certain relation effect between the conduction electrons, which is usually ored. The same problem is then treated by the method of ajima (1954) and Bardeen and Pines (Abstr. 8948 of 1955) and it shown that it leads to essentially the same result as that obtained the Thomas—Fermi method The potential differs from the al one in that the screening parameter now depends on the nner of scattering. The equivalence of the two methods is dis- sed and further possible improvement suggested. The potential ived is used to calculate the electric resistance governed by urity scattering.

539.2 : 537.3

20860 ELECTRICAL RESISTANCE OF FERROMAGNETIC METALS. I.Mannari.

ogr. theor. Phys., Vol. 22, No. 3, 335-43 (Sept., 1959).

A model is used for ferromagnets such that the electrical rrent is carried by 4s (or 6s) electrons, which are assumed to described in band scheme, and the unpaired electrons (3d or are assumed to be localized on the lattice points. In the nperature region far below the Curie point the spin-disorder in n orientation, which can be naturally described in terms of spin- ves, gives rise to the scattering of conduction electrons through s—d interaction and accordingly contributes to the anomalous rt of the resistivity of type T^2, which agrees fairly well with the perimental results both in order of magnitude and in temperature pendence. The effects of the lattice vibration are also discussed d turn out to give only a small additional contribution of type T^5.

539.2 : 537.3

20861 THE RESISTANCE MINIMUM IN DILUTE ALLOYS OF TIN IN COPPER.

B.Pearson, D.M.Rimek and I.M.Templeton.

il. Mag. (Eighth Ser.), Vol. 4, 612-21 (May, 1959).

Previous experimental work on the resistance minimum used by tin in dilute solid solution in polycrystalline copper led the expectation that there might be no minimum in similar alloys ich were single crystals. This is found to be the case, and the nimum can be produced by making the monocrystalline alloys ycrystalline. It is suggested that the resistance minimum curs as a result of segregation of the tin atoms on the grain undaries of the polycrystalline alloys. For dilute alloys of iron in pper there was, as expected, practically no difference in the sistance minimum observed in polycrystalline and in mono- ystalline alloys.

539.2 : 537.3 : 538.1 : 621.318.381

MAGNETORESISTANCE OF Cu AT LOW TEMPERATURES. e Abstr. 19877

539.2 : 537.3

20862 EXPERIMENTS ON THE RESISTANCE MINIMUM. THE EFFECTS OF CERTAIN SOLUTES IN COPPER, SILVER AND GOLD. W.B.Pearson.

Phil. Mag. (Eighth Ser.), Vol. 4, 622-7 (May, 1959).

In an attempt to increase the knowledge of what chemical impurity atoms give rise to a resistance minimum in copper, silver, and gold as solvents, we have examined dilute polycrystalline solid solutions of Ni, Cu, and Sn in Au, Sn in Ag, and Mg in Cu, which were of some interest. It appears that none of these particular solutes causes a resistance minimum in the solvents specified. This finding is discussed in relation to previous work.

539.2 : 537.3

20863 RECOVERY OF QUENCHED-IN RESISTIVITY AT HIGH TEMPERATURES IN GOLD.

M.Meshii and J.W.Kauffman.

Phil. Mag. (Eighth Ser.), Vol. 5, 687-90 (July, 1960).

For quenches made from 1000°C, 90% of the quenched-in resistivity anneals out in the vicinity of room temperature leaving 10% which subsequently recovers only at much higher temperatures. This remaining resistivity is associated with configurations which are formed from the quenched-in vacancies. The recovery of this remaining resistivity was studied. Two recovery regions were defined: The first region was found within a wide temperature range, 200° to 600°C; the second region was observed within a very narrow temperature range about 630°C. Complete recovery occurred during this stage. The recovery in the temperature range 200° to 600°C had no observable effect on the yield stress. However, the second step of the resistivity recovery observed in a narrow temperature range above 600°C corresponds to the resoftening of quench-hardening.

539.2 : 537.3

20864 RESISTIVITY OF PURE IRON IRRADIATED BY NEUTRONS. C.Cassayre, D.Dautreppe and J.Paulevé.

C.R. Acad. Sci. (Paris), Vol. 251, No. 3, 370-2 (July 18, 1960). In French.

Three samples of pure iron were irradiated at 35°C to an integrated neutron flux of about 10^{18} nvt (fast) in the swimming pool reactor "Mélusine", and the resistivity measured at 20°K. This resistivity was found to increase by a factor of up to two, depending on the purity as measured by the ratio of the resistivity at 20°K to that at 293°K before irradiation. The purer the sample the less was found to be the effect. Irradiation at 78°K was found to increase the effect by about ten times. The annealing behaviour was also studied. J.Thewlis

539.2 : 537.3 : 537.534

20865 EFFECT OF HYDROGEN-ION BOMBARDMENT ON THE OXIDES OF ALUMINIUM AND MAGNESIUM.

L.B.Griffiths.

Nature (London), Vol. 188, 43 (Oct. 1, 1960).

High-purity polycrystalline samples of Al_2O_3 and MgO were bombarded by a 300 μA beam of H ions with an energy peak at 500 eV. Changes in electrical resistance were used as a convenient means of following the effect of the bombardment. This effect was to reduce the resistance considerably with increasing duration of bombardment, no sign of saturation being observed up to 300 sec. Full recovery of the original value occurred at room temperature, for both materials, at a rate strongly dependent on the square root of the time, which is suggestive of a diffusion mechanism. J.Thewlis

539.2 : 537.3

20866 KINETICS OF ORDERING IN Fe_3Al. R.Feder and R.W.Cahn.

Phil. Mag. (Eighth Ser.), Vol. 5, 343-53 (April, 1960).

The resistance changes produced by thermal treatment of Fe_3Al were measured and the annealing kinetics analysed. It is found that an increase in long-range order produced a large decrease in resistance. It was found that the rate at which ordering takes place is a function of the initial quenching temperature. All curves were fitted to the standard rate equation giving an order of reaction n = 2.2 for specimens quenched from 620°C and n = 1.5 for specimens quenched from 530°C. The activation energy obtained from resistivity kinetics was found to be much lower than the mean activation energy for diffusion.

539.2 : 537.3

20867 THE ELECTRICAL RESISTANCE OF IRON–ALUMINIUM ALLOYS AND ITS DEPENDENCE ON CRYSTALLOGRAPHIC ORDER. R.W.Cahn and R.Feder.

Phil. Mag. (Eighth Ser.), Vol. 5, 451-65 (May, 1960).

The electrical resistance of two iron–aluminium alloys, bordering on the composition Fe_3Al, was measured at room and liquid nitrogen temperatures after inducing various states of order. By means of an analysis based on values of residual resistivity and of the temperature coefficient of resistivity, the influence of order on electronic factors in the conductivity, and on the perturbations of the lattice that produce scattering, were separately estimated. The freedom of conduction electrons diminishes as the order increases, and the decrease in low temperature resistivity associated with increasing order is due to the greatly reduced scattering potential. These conclusions permitted a qualitative interpretation of the form of the anomalous resistance/temperature relation at high temperatures.

539.2 : 537.3

20868 SOME PHYSICAL PROPERTIES OF ALLOYS OF 0.007 ~ 5.4% Mn IN Cu.

Y.Shibuya, Y.Tawara, S.Tanuma, Y.Saito, Y.Muto and T.Fukuroi.
Physica, Vol. 24, Supplement, S175 (Sept., 1958).

Low Temperature Physics Conference (see Abstr. 7017 of 1960). Brief note, substantially as follows: The relative resistance γ_T for the maximum or the minimum of the resistance plotted against temperature where the maximum or the minimum occurred was similar to that for Ag–Mn alloys obtained by Gerritsen and Linde. The magnetoresistance was negative in the temperature range of the resistance maximum and positive in that range of the resistance minimum. The Hall coefficient of very dilute alloys increased with decrease in temperature. A correspondence between the thermoelectric power and the resistance was found at low temperatures, the sign of the thermoelectric power changing from positive to negative with the increase in temperature. The magnetic susceptibility showed antiferromagnetic-like behaviour at low temperatures. The temperature corresponding to the susceptibility maximum seemed to decrease with the decrease in the Mn concentration. The specific heat of 0.24, 0.082 and 0.037% Mn alloys suggested that alloys having the Mn concentration between 0.24 and 0.082 show the specific heat associated with the magnetic transformation in the temperature range from 1.4 to 4.2°K.

539.2 : 537.3

20869 HALL EFFECT AND RESISTIVITY OF Ni–Pd ALLOYS. J.A.Dreesen and E.M.Pugh.

Phys. Rev., Vol. 120, No. 4, 1218-23 (Nov. 15, 1960).

The two Hall coefficients and the resistivity were measured from 4°K to room temperature using fields up to 3.1 webers/m^2. The ordinary Hall coefficient is found to decrease in magnitude for small additions of Pd in Ni, but to increase as more Pd is added. It is also found that the ordinary Hall coefficient varies more slowly with composition for these alloys than it does for the Ni–Cu alloys. It is shown that a simple treatment successfully correlates the ordinary Hall coefficient, the resistivity, and the saturation magnetization of these alloys. The results indicate that the parallel half of the d-band in pure Ni is not quite full at the absolute zero of temperature, and that the relaxation time is not a function only of the energy for the thermal scattering in these alloys. The extraordinary Hall coefficient is found to obey none of the variously proposed theoretical relations.

539.2 : 537.3

20870 THE STRAIN DEPENDENCE OF THE RESIDUAL RESISTIVITY OF POTASSIUM.

Z.S.Basinski, J.S.Dugdale and D.Gugan.
Phil. Mag. (Eighth Ser.), Vol. 4, 880-3 (July, 1959).

The variation of electrical resistivity with strain, of wires of lithium, sodium and potassium were measured at low temperatures (down to 4°K). The experiments on potassium were done for comparison since both lithium and sodium undergo a low temperature martensitic transformation whereas potassium does not. The author's results on lithium and sodium agree with the results of Hull and Rosenberg (Abstr. 16215 of 1960) but their results for potassium do not agree. In fact they find that the strain dependence of electrical resistivity for both sodium and potassium at 4°K are very similar. Since stacking faults are thought to be present only in the h.c.p. phase of sodium, this similarity of behaviour is used to refute the idea that stacking faults are the dominant source of electron scattering in sodium. R.Bullough

539.2 : 5

20871 ELECTRONIC CONDUCTIVITY OF SILVER HALIDE CRYSTALS. J.W.Mitchell.

Progress in semiconductors, Vol. 3 (London: Heywood. 1958) p. 53-82.

A review article with 100 references. The discussion of crystal preparation includes preparation of molten silver halide large single crystals, mixed crystals, specimens for photoconductivity measurements and crystal counters, the annealing of specimens, and electrodes. The optical absorption spectra of pu and mixed crystals, and absorption due to colloidal silver are th surveyed. Methods of measurement and results of electronic co ductivity at room temperature are considered, including the use of d.c. amplifiers, pulse methods and pulse techniques based on observations of photolytic silver and latent images. Low temper ture measurements discussed include d.c. and a.c. bridge measu- ments, the crystal counter, the temperature dependence of electron mobility, and electronic dark currents. In the final section, attention is drawn to a number of features of fundamenta importance for future research work. J.B.Bi

539.2 : 537.3 : 535

THE EFFECT OF ANNEALING ON THE ELECTRICAL CONDUCTIVITY OF NaCl:Pb AND KCl:Pb. See Abstr. 20990

539.2 : 53

20872 IONIC CONDUCTION IN β-Ag_2Te AND β-Ag_2Se. S.Miyatani.

J. Phys. Soc. Japan, Vol. 14, No. 8, 996-1002 (Aug., 1959).

The ionic conductivity σ_i is estimated from the time constan of the ionic polarization obtained using the galvanic cell Ag|AgI| specimen|Pt. It is shown that σ_i depends on composition (deviati from the stoichiometric ratio) in contrast to the composition-independent σ_i in the α-phase. The chemical potential ζ_i of the Ag ion, known from the e.m.f. E of the cell, is also dependent on t composition in the β-phase, and accordingly E does not represent the relative position of the Fermi level as in the α-phase. This composition dependence of ζ_i and σ_i is accounted for by a simple theory. In addition, the electronic properties measured as functio of E are also compared with the theory.

539.2 : 53

20873 ELECTRICAL CONDUCTIVITY OF STRONTIUM OXID M.J.Adams and L.Jacob.

Nature (London), Vol. 188, 130-1 (Oct. 8, 1960).

The electrical conductivity of strontium oxide as a function o applied field has been determined over the temperature range 800-1200°K. For applied voltages above about 20 V and temperatu below about 1000°K, conductivity is practically independent of fiel at low voltages, however, conductivity increases with increasing voltage. Possible reasons for this behaviour are discussed. C.H.B.M

539.2 : 53

20874 THE OSCILLATORY DEPENDENCE OF THE SURFAC RESISTANCE OF A METAL ON A WEAK MAGNETIC FIELD. M.S.Khaikin.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 212-14 (July, 1960). In Russian.

The experiment was carried out by a frequency modulation method at 9.4 kMc/s on single crystals of very pure tin (impurity concentration $< 6 \times 10^{-5}\%$). Oscillations were observed for $H \cong 5$ gauss except when H was perpendicular to H_{rf}. They are not periodic in 1/H and are discernable only below 10°K. A similar effect was observed in a very pure cadmium sample. M.G.Priest

539.2 : 53

20875 THE NON-MONOTONIC DEPENDENCE OF THE SURFACE IMPEDANCE OF TIN ON MAGNETIC FIEL AT A FREQUENCY OF 1.9 Mc/s.

V.F.Gantmakher and Yu.V.Sharvin.
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 512-13 (Aug., 1960). In Russian.

The reactive part of the surface impedance was determined a helium temperatures by measuring the change in frequency of a resonator. The resistance ratio $\rho(20°C)/\rho(4.2°K)$ of the tin samp was 1×10^5. The effect was not observed in less pure tin sample M.G.Priest

conductors

539.2 : 537.311

376

FLUCTUATIONS IN SOLIDS.

J.J.Brophy.

Today, Vol. 13, No. 10, 38-41 (Oct., 1960).

Report of the fourth annual symposium held at the Arrow arch Foundation, Chicago, on 5 May, 1960. No formal papers presented. The discussion ranged over a wide field covering experimental and theoretical aspects of noise in semiconductors hotoconductors.

539.2 : 537.311 : 621.382

877

PROGRESS IN SEMICONDUCTORS. VOL. 1.

Edited by A.F.Gibson, R.E.Burgess and P.Aigrain.

don: Heywood and Co. Ltd (1956) 220 + vii pp.

The first in an annual series which aims to "cover all aspects emiconductors including, at least to a limited extent, applica- s of semiconductor devices." It contains 7 review articles, a ace and a short index. J.B.Birks

539.2 : 537.311 : 621.382

0878

PROGRESS IN SEMICONDUCTORS. VOL. 2.

Edited by A.F.Gibson, R.E.Burgess and P.Aigrain.

don: Heywood and Co. Ltd. (1957) 280 + vii pp.

This second volume of this series contains 8 articles, a preface a short index. J.B.Birks

539.2 : 537.311 : 621.382

0879

PROGRESS IN SEMICONDUCTORS, VOL. 3.

Edited by A.F.Gibson, R.E.Burgess and P.Aigrain.

don: Heywood and Co. Ltd (1958) 210 + vii pp.

This third volume of the series contains 7 articles, a preface and ort index. J.B.Birks

539.2 : 537.311

0880

CONDUCTIVITY IN ELECTRON—HOLE JUNCTIONS IN REVERSE DIRECTION.

V.I.Fistul'and O.B.Orzhevskii.

tverdogo Tela, Vol. 2, No. 9, 2214-17 (Sept., 1960). In Russian.

An analysis of an open junction is undertaken, starting with kley's basic equation for the saturation current = A exp $(-q\phi/KT)$ re ϕ is the activation energy of minority charge carriers. tionships between current, contact potential, applied voltage E depletion layer and depletion layer capacitance are considered for alloyed and diffused junctions. Experimental investigations er point and junction diodes of germanium, silicon and selenium and ude the effect of temperature on main parameters. Results indi- that the absence of a reverse saturation current can be explained he reduction of activation energy ϕ by a factor $\Delta \phi \sim \sqrt{E}$. A.Landman

539.2 : 537.311

20881

ON THE NON-ISOTHERMAL DIFFUSION THEORY OF RECTIFIERS.

T.Numata.

Phys. Soc. Japan, Vol. 14, No. 7, 902-13 (July, 1959).

The theory is derived using the non-isothermal diffusion equa- n deduced from the formal theory of conduction. The rectifica- n equation obtained depends upon temperature distribution in a rrier. If a temperature difference exists between the ends of the rrier, then the appearance of thermoelectromotive force is pre- ted. Taking into account the non-isothermal property of the rrier, the theory shows the tendency that the values of the dielec- c constants of barrier materials for Cu_2O and Se rectifiers deter- ned from the capacitance—voltage characteristics seem to proach those of the bulk materials of Cu_2O and Se, respectively.

539.2 : 537.311

20882

EFFECT OF EXTERNAL ILLUMINATION ON CARRIER LIFETIME IN SEMICONDUCTORS.

J.Okada.

Phys. Soc. Japan, Vol. 14, No. 11, 1550-7 (Nov., 1959).

The lifetime of excess carriers in a nondegenerate semi- nductor which is illuminated with a light in the fundamental absorp- on band and a longer wavelength light is discussed. The recom- nation equations for many recombination-centre levels in the pre- nce of a steady external illumination are formulated. For steady- ate case these equations can be solved exactly, but transient solu- ons are obtained only for specific cases. These results show that th steady-state and transient lifetimes are identical for small nsities of recombination centres. This simple lifetime for single combination-centre level case is discussed.

539.2 : 537.311

20883

MAGNETO-ELECTRICAL FIELD-EFFECT MEASUREMENTS.

E.Aerts.

J. Electronics and Control, Vol. 9, No. 3, 217-28 (Sept., 1960).

Experimental results are given on the influence of combined orthogonal transverse electric and magnetic fields on the mobility of the carriers in the space charge layer at the surface of a semiconductor. In particular, it is shown that the Hall field could change the type of surface layer. It is found that for weak field the mobility of the carriers is proportional to the Hall field. By combining the electric and magnetic field effects in different ambients several regions of the Schrieffer curve could be explored. Temperature effects were also studied and it was found that it was more difficult to invert the surface at a high temperature.

539.2 : 537.311

20884

DRIFT AND HALL MOBILITIES OF ELECTRONS IN NONDEGENERATE IMPURE N-SEMICONDUCTORS.

M.S.Sodha and P.C.Eastman.

Progr. theor. Phys., Vol. 21, No. 1, 214-16 (Jan., 1959).

The authors have modified the expression for time of relaxation of an electron due to ionized impurity scattering, obtained by Brooks [Phys. Rev., Vol. 83, No. 4, 879 (Aug. 15, 1951)] to take electron—electron scattering into account. This expression has been used to numerically evaluate the variation of drift and Hall mobilities with $b = 2\pi D m(kT)^2/k^2q^2n$, where q, m and n are the charge, effective mass and number density of electrons and D and T are the dielectric constant and temperature of the crystal. Approximate analytical expressions are also given. The poor validity of the theory for commonly studied semiconductors has also been pointed out. M.S.Sodha

539.2 : 537.311

20885

RETARDATION TIMES OF NONEQUILIBRIUM CURRENT CARRIERS IN SEMICONDUCTORS.

O.N.Krokhin and Y.M.Popov.

Zh. eksper. teor. Fiz., Vol. 38, No. 5, 1589-92 (1960). In Russian.

Retardation times are derived for electrons and holes which are not in thermal equilibrium with the semiconductor lattice. It is shown that allowance for degeneracy does not appreciably affect the retardation times.

539.2 : 537.311 : 539.1.07

20886

MEASUREMENT OF THE COEFFICIENT OF CHARGE COLLECTION IN p—n JUNCTION PARTICLE DETECTORS: NEW METHOD OF MEASURING LIFE TIMES.

L.Koch, J.Messier and Q.Kerns.

J. Electronics and Control, Vol. 8, No. 4, 289-300 (April, 1960). In French.

Junctions were made by diffusion of arsenic into germanium. Higher resolution at lower particle energies can be obtained by reducing junction capacity (wider junctions or n—i—p structures). Linear response to particle energy is greater the thicker the junction and the longer the carrier life time. Diffusion lengths greater than 5μ can be determined with 6 μ accuracy if the thickness of the transition region is of the same order. Use of collimated α particle beams enables life times to be measured for very specific regions of crystals containing p—n junctions. G.F.J.Garlick

539.2 : 537.311 : 621.382

20887

THE ELECTRICAL PROPERTIES OF PHOSPHORS.

G.F.J.Garlick.

Progress in semiconductors, Vol. 1 (London: Heywood, 1956) p. 99-133.

A survey of the electrical and associated optical properties of sulphide phosphors, with particular reference to single-crystal studies. After an introductory description of the general characteristics of sulphide phosphors, their synthesis, energy states and processes, there is a discussion of photoconductivity and dielectric changes in microcrystalline phosphors. The following section on electrical conduction in single-crystal phosphors discusses luminescence, photoconduction and semiconduction and their experimental and theoretical relations. The final section deals with the effects of strong electric fields such as the Gudden-Pohl effect, dielectric breakdown, electroluminescence and light amplification. 72 references, mainly post-1948, are given. J.B.Birks

539.2 : 537.311 : 621.382.333

20888

THE DESIGN OF TRANSISTORS TO OPERATE AT HIGH FREQUENCIES.

J.Evans.

Progress in semiconductors, Vol. 1 (London: Heywood. 1956) p. 135-[illegible].

Reviews the state of knowledge up to June 1955 on h.f. transistors. Types considered include grown n—p—n junctions, junction transistor tetrodes, alloy p—n—p junctions, surface-barrier, p—n—i—p, unipolar field-effect, point-contact and two-electrode devices. 27 references. J.B.Birks

539.2 : 537.311 : 621.382

20889 PHOTO-MAGNETO-ELECTRIC EFFECT IN SEMICONDUCTORS.

O.Garreta and J.Grosvalet.

Progress in semiconductors, Vol. 1 (London: Heywood. 1956) p. 165-94.

An exposition of the theory of the p.m.e. and related effects is given. Experimental results on the p.m.e. effect in germanium, silicon (including previously unpublished data), lead sulphide and indium antimonide are reviewed. Methods of measuring lifetime and surface recombination velocity from the effect are considered. 19 references. J.B,Birks

539.2 : 537.311 : 621.382

20890 FIELD EFFECT IN SEMICONDUCTORS.

L.R.Godefroy.

Progress in semiconductors, Vol. 1 (London: Heywood. 1956) p. 195-217.

When a thin sample of semiconductor is used as a plate of a capacitor, the other plate being a metal, the resistance of the sample varies with the charge on the capacitor. This variation is known as the "field effect". This article reviews the theory of the effect, the experimental methods used to study it, and discusses results obtained. The application to the study of ferroelectrics is briefly considered. 15 references. J.B.Birks

539.2 : 537.311 : 621.382

20891 SEMICONDUCTOR ALLOYS.

F.Herman, M.Glicksman and R.H.Parmenter.

Progress in semiconductors, Vol. 2 (London: Heywood. 1957) p. 1-33

Reviews work up to mid-1956 on crystalline semiconductors whose atomic structure is characterized by a substantial degree of disorder. These semiconductor alloys are classified as lightly doped ordered crystals, crystals with missing or extra host atoms, heavily doped crystals, mixed crystals, crystals with random stacking, and crystals with randomly arranged host atoms. The properties discussed are the one-electron energy levels, the lattice vibrational spectrum, the optical properties, and the transport properties. 78 references. J.B.Birks

539.2 : 537.311 : 621.382

20892 LIFETIMES OF FREE ELECTRONS AND HOLES IN SOLIDS.

A.Rose.

Progress in semiconductors, Vol. 2 (London: Heywood. 1957) p. 109-36.

This subject is of importance in the fields of luminescence, photoconductivity and semiconductor devices. The analysis of the factors controlling lifetimes normally introduces complexities of mathematical relations and/or physical concepts. One aim of this paper is to relieve this complexity, by a suitable choice of approximations and concepts; the other is to develop a method of analysis which is flexible within wide limits. The model adopted considers demarcation levels for the electrons and holes, and the effect of either excited densities or thermal carrier densities being predominant. The transition from semiconductors to insulators is briefly discussed. The paper is largely non-mathematical, apart from two short appendices, where the basic equations are derived. J.B.Birks

539.2 : 537.311 : 621.382

20893 HIGH ELECTRIC FIELD EFFECTS IN SEMICONDUCTORS.

J.B.Gunn.

Progress in semiconductors, Vol. 2 (London: Heywood. 1957) p. 211-47.

The theory of mobility changes in semiconductors under high electric fields, and of avalanche ionization, breakdown in a p—n junction, avalanche injection, and an avalanche at a current constriction is surveyed in detail. The review of the experimental results on germanium and silicon includes small quadratic changes in mobility, major variations of mobility, avalanché ionization and p—n junction breakdown, light emission from an avalanche, avalanche injection, and the resistance of a current constriction. 35 references. J.B.Birks

539.2 : 537.311 : 62

20894 LIFETIME OF EXCESS CARRIERS IN SEMICONDU

A.Many and R.Bray.

Progress in semiconductors, Vol. 3 (London: Heywood. 1958) p. 117-151.

Reviews the major recombination processes that have been applicable. Topics discussed include non-equilibrium phenomen lifetime, production and detection of excess carriers, and bulk a surface recombination; band-to-band transitions; transitions bet bands and localized levels; simple recombination via imperfecti general expressions for bulk lifetime, low-level lifetime, high-l lifetime and surface recombination; and trapping and recombina a single set and at separate sets of imperfection levels. 82 refe ences. J.B.B

539.2 : 537.

20895 ROLE OF MINORITY CURRENT CARRIERS IN THE PROCESS OF ANODIC DISSOLUTION OF N-TYPE G

Yu.V.Pleskov.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 6, 1360-3 (June 21, 1960). In Russian.

The method developed by Brattain and Garrett (Abstr. 4650 o 1955) was used for the measurement of α' (current multiplicatio factor) as a function of conditions of the anodic dissolution of Ge. The values obtained agree with both other experimental results a with results of indirect calculations at small values of the injecti current; the magnitude α' is independent of the potential of Ge an is the same for dissolution in 1N H_2SO_4 and in 1N KOH. At higher injection current values, α' decreases. F.Lachm

539.2 : 537.3

20896 RECOMBINATION OF ELECTRONS AND HOLES ON COPPER AND NICKEL ATOMS IN HIGH-RESISTANC GERMANIUM.

V.V.Rȳbalka and A.S.Pizio.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1773-5 (Aug., 1960). In Russian

The carrier lifetime was measured in 20-50 ohm cm n-type germanium samples, alloyed with copper or nickel by vacuum diffusion at 540-600°C. The results were satisfactorily interpret in terms of recombination at multicharged traps. A.Tybulew

539.2 : 537.3

20897 THE ELECTRICAL CONDUCTIVITY OF DEPOSITED GERMANIUM LAYERS.

P.P.Konorov and O.V.Romar

Fiz. tverdogo Tela, Vol. 2, No. 8, 1869-73 (Aug., 1960). In Russia

Reports a study of the electrical conductivity, structure and optical absorption of thin germanium layers prepared by depositio in vacuum on glass bases (the evaporation sources were a tungste spiral and a graphite-lined quartz crucible). The conductivity act vation energy depended on the layer thickness: 0.5 eV for 0.05 μ layers and 0.9 eV for 0.6 μ layers. On heating above 120°C the layers, which were amorphous after deposition, crystallized out. heating was carried out in air the layers were oxidized as well. Properties of the layers prepared using the tungsten spiral differe from properties of the layers deposited from the quartz crucible. is suggested that in the first case germanium was alloyed with tur sten, which was forced out of germanium on crystallization. Changes in the conductivity activation energy produced by heat tre ment agreed with the corresponding changes in the position of the optical absorption edge. A.Tybulewi

539.2 : 537.3

20898 THE ELECTRICAL CONDUCTIVITY OF GERMANIUM AT LOW TEMPERATURES.

S.G.Kalashnikov and I.A.Kurova.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1949-50 (Aug., 1960). In Russia

Between 2° and 4°K, an extremely weak ($< 10^{-10}$ W/cm^2) stray long-wavelength radiation increased the electrical conductivity an altered the Hall constant and magnetoresistance of germanium containing about 10^{15} cm^{-3} Sb. When this radiation was filtered of the anomalies disappeared. A.Tybulewi

539.2 : 537.3

20899 VOLT—AMP CHARACTERISTICS OF THE DEPLETIC LAYER OF A GERMANIUM P—N JUNCTION IN FORWARD DIRECTION.

F.M.Berkovskii, S.M.Rȳvkin and N.B.Stroka

Fiz. tverdogo Tela, Vol. 2, No. 8, 1956-61 (Aug., 1960). In Russia

An experimental investigation of the classic Shockley equatio $I = I\ [\exp(q\phi/kT)-1]$ is undertaken into the regions of high potent ϕ and high current densities, based on work by Barrick (Abstr. 4 of 1958) and following a measurement technique first suggested by Gossick (Abstr. 1237 of 1956). It consists in sudd... interruption ent through the junction, leaving a linearly decaying potential rmined by the life time of holes in the base. The relationship een this inertial component and the Dember potential (given by lifference of electron and hole mobilities) is analysed, and the r is plotted versus junction potential, with varying base conivity as parameter. The experimental set-up consists of a cur- square pulse generator, a relay operated voltage comparator an oscilloscope attachment. Typical results are tabulated and ed, it is being found that in the region of current density of 0.1)0 A cm^{-2} and from −77°to 70° C Shockley's formula is confirmed. ond 100 A cm^{-2} the junction potential reaches saturation which is r than the contact potential by 60-70 mV, yet the extrapolation of volt—amp characteristic at high currents indicates a value exling the contact potential. A.Landman

539.2 : 537.311

20900 LOW-INERTIA GERMANIUM PHOTODIODES.
S.M.Ryvkin, R.F.Konopleva, L.V.Maslova, O.A.Matveev, .Strokan, D.V.Tarkhin and G.V.Khozov.

. tverdogo Tela, Vol. 2, No. 9, 2199-201 (Sept., 1960). In Russian.

Two photodiodes with short time constants were prepared. ir sensitive areas were 0.2 and 1.0 mm^2, respectively, with k currents of 0.2 to 1.0 and 5.0 to 10.0 μA. The breakdown volt- was found to be about 30 V for both devices, and the sensitivity asured with an incandescent lamp of colour temperature 2850° K found to vary from 15 × 10^3 to 20 × 10^3 μA/lm. The capacity he junction region was of the order of 20 and 50 pF, respectively, h a base resistance of 100 ohms. The time constant was measured found to be between 1 and 3 × 10^{-8} sec. K.N.R.Taylor

539.2 : 537 311

20901 THE FIELD DEPENDENCE OF THE MOBILITY OF ELECTRONS IN n-GERMANIUM. H.Sato.

Phys. Soc. Japan, Vol. 14, No. 10, 1275-85 (Oct., 1959)

The mobility of electrons in n-Ge at an arbitrary field strength calculated by assuming a distribution function f(p) in the form

$$f(p) = A \exp\left(-\frac{|p + p_0|^2}{2mkT}\right),$$

ere T is the electron temperature and p_0 represents the uniform splacement of the electron distribution in the direction of the elec- c field. The two parameters T and p_0 are determined by the thod of Fröhlich and Paranjape (Abstr. 2144 of 1956). Interaction nstants between electrons and acoustical and optical modes of oration are determined from the temperature dependence of the ro-field mobility. At room temperature it is found that the elec- on temperature is determined mainly by optical-mode scattering low fields, but that the energy loss of electrons due to acoustical- de scattering cannot be neglected at very high fields. Conseently the current density versus electric field relation becomes ich different from Shockley's predictions. Agreement with perimental results becomes more satisfactory.

539.2 : 537.311

20902 IMPURITY CONDUCTION IN INDIUM-DOPED GERMANIUM. J.S.Blakemore.

nil. Mag. (Eighth Ser.), Vol. 4, 560-76 (May, 1959).

Studies were made of electrical conductivity at low temperares in germanium crystals grown with indium and antimony as ajority and minority impurities respectively. The indium densies were kept small enough (<2 × 10^{16} cm^{-3}) to ensure that imirity conduction was controlled by the degree of compensation, hich was carefully determined from Hall and resistive behaviour the extrinsic temperature range. The impurity conduction esults illustrate trapping of electrons on preferred acceptor sites the lowest temperatures, in accordance with the model recently ostulated by Mott (Abstr. 9174 of 1957) and elaborated by Price . Phys. Chem. Solids, Vol. 2, 282 (1957) and Abstr. 2864 B of 958; I.B.M. J. Res. Developm., Vol. 2, No. 2, 123-9 (April, 1958)]. he trapping energy ϵ_t is some 10^{-3} eV. The mobility of electrons volved in the impurity conduction process appears to be essenally temperature independent — a result at variance with the preictions of Conwell (Abstr. 6637 of 1956). However the increase of obility with impurity density does generally follow the lines of onwell's model.

539.2 : 537.311

20903 VALLEY–ORBIT SPLITTING OF ANTIMONY IN GERMANIUM. H.Fritzsche.

hys. Rev., Vol. 120, No. 4, 1120-4 (Nov. 15, 1960).

The change of electrical conductivity under uniaxial tension and compression was measured over the range 4° to 7° K for single-crystal specimens of germanium doped with antimony. The stress was varied from 1 × 10^7 to 5 × 10^8 dynes/cm^2. On the basis of Price's calculation of the effect of shear on the Kohn–Luttinger donor level structure, an expression for the piezoresistance has been derived, which includes terms of high order in the strain. It is shown that for a finite valley–orbit splitting, i.e., a finite energy separation between the onefold and the threefold 1s-like donor states, shear increases the total electron concentration in the conduction band. For uniaxial stresses along the [110] direction this increase in electron concentration is an even function of stress and can, therefore, be determined from a linear combination of the piezoresistance measured under tension and compression. A comparison of the theoretical expression with the experimentally obtained change in electron concentration yields for antimony in germanium a valley–orbit splitting of 0.57 ± 0.03 milli-electron volt.

539.2 : 537.311

20904 ANISOTROPY OF HOT ELECTRONS IN GERMANIUM. W.Sasaki.

Researches Electrotech. Lab. (Tokyo), No. 583, 27 pp. (Dec., 1959). In Japanese.

Electric conduction in cubic crystals becomes anisotropic under high electric fields where Ohm's law fails. When the conduction becomes anisotropic, the direction of the electric field vector is not always parallel to that of the current vector, and the deviation can be measured in terms of the electric field perpendicular to the current direction. This effect was measured in n- and p-type germanium as a function of electric field strength, temperature, and current direction. The anisotropy angle ϵ between the electric field and current vectors increases with increasing electric field strength in the low field region, attains its maximum at the value of electric field for which the current increases nearly in proportion to the square root of electric field strength, and decreases with increasing field in the higher electric field region. The maximum value of ϵ and the corresponding value of the field strength vary with the type of conduction, the direction of the electric field and temperature. This variation can be understood from the shape of energy surfaces of the electrons and holes in the k-space. A phenomenological discussion shows how the k-space distribution of the electrons or holes is altered under high electric fields from that under thermal equilibrium.

539.2 : 537.311 : 621.382

20905 THE GERMANIUM FILAMENT IN SEMICONDUCTOR RESEARCH. C.A.Hogarth.

Progress in semiconductors, Vol. 1 (London: Heywood, 1956) p. 37-62.

Reviews experiments carried out using germanium filaments, and the way they have suggested interpretations of the fundamental processes taking place in semiconductors under non-equilibrium conditions. After discussing such practical considerations as filament size, end contacts, surface treatments, probe contacts and mounting, the various types of experiment are reviewed. These include the measurement of drift mobility and its variation with temperature and other parameters; lifetime measurements by several methods; measurement of surface recombination velocity; diffusion constant; injection ratio and its measurement; filamentary transistors; noise; carrier concentration disturbances; and other experiments. 71 references, up to 1955, are given.

J.B.Birks

539.2 : 537.311 : 621.382

20906 SCATTERING AND DRIFT MOBILITY OF CARRIERS IN GERMANIUM. M.S.Sodha.

Progress in semiconductors, Vol. 3 (London: Heywood. 1958) p. 153-179.

A theoretical discussion, mainly in terms of the simple model of the band structure of semiconductors. Topics considered are scattering of carriers by acoustical modes, optical modes, ionized impurities, neutral impurities and dislocations; mobility of carriers in zero field — general, lattice mobility, ionized impurity mobility, neutral impurity and dislocation mobility, and carrier-carrier scattering mobility; the combination of mobilities; the many-valley model — mobility, acoustic mobility and inter-valley scattering; mobility at moderate fields and at high fields; and hole mobility at very high fields. 45 references. J.B.Birks

539.2 : 537.311 : 621.382

20907 THE MAGNETORESISTIVITY OF GERMANIUM AND SILICON. M.Glicksman.

Progress in semiconductors, Vol. 3 (London: Heywood. 1958) p. 1-25.

Basic information on the shape of the energy surfaces in germanium and silicon has been afforded by both diamagnetic resonance (high-frequency magnetoresistance) and d.c. magnetoresistance experiments, which are reviewed. The high-frequency measurements yield more detail about the effective mass and relaxation time, but require special conditions in the material. The d.c. observations provide valuable information on the band structure and relaxation time, especially if the energy surfaces are not too complex. As the result of these measurements the detailed structure at the bottom of the conduction band and the top of the valence band in Ge and Si are known. In general, theory and experiment are in good qualitative agreement, but the present approximate theory is unable to give quantitative agreement. Three areas are indicated where further theoretical and experimental work is necessary. 60 references. J.B.Birks

539.2 : 537.311 : 621.382

20908 THE CHEMICAL PURIFICATION OF GERMANIUM AND SILICON. J.M.Wilson.

Progress in semiconductors, Vol. 3 (London: Heywood. 1958) p. 27-51.

A review paper with 71 references. For germanium, the occurrence, preparation and properties of the element and some of its compounds, commercial recovery processes, purification of germanium tetrachloride, preparation of high-purity germanium oxide, recovery of scrap germanium, production of intrinsic germanium, extraction processes and solvent extraction are considered. For silicon its occurrence, normal preparation, methods of preparation of high-purity silicon, further purification, silane silicon, and the purity obtained by various methods are discussed. The final section deals with methods of evaluation and analysis. J.B.Birks

539.2 : 537.311

20909 VISIBLE LIGHT EMISSION FROM METAL–SILICON CONTACT. M.Kikuchi.

J. Phys. Soc. Japan, Vol. 14, No. 5, 682 (May, 1959).

A small silver-paste electrode in contact with a silicon crystal showed strong rectifying characteristics, and in the reverse direction light emission took place at the electrode periphery. Immersion in oil did not substantially affect the light emission, so apparently excluding an air discharge as a possible cause. External light pulses falling on the electrode periphery substantially enhanced the light emission. F.Ansbacher

539.2 : 537.311

20910 EFFECTS OF HEAT TREATMENT UPON THE ELECTRICAL PROPERTIES OF SILICON. Y.Matukura.

J. Phys. Soc. Japan, Vol. 14, No. 7, 918-23 (July, 1959).

Experimental studies were made of the processes in which changes of the carrier concentration and minority carrier lifetime are introduced into silicon by heat treatment in the temperature range 400°-1200°C. In the low temperature heat treatment, less donors are formed in the vicinity of crystal defects. In the high temperature heat treatment, a decrease of carrier density in p- and n-type crystals is observed in addition to the annihilation of the formed donors. These behaviours are closely related to the crystal defects. The characteristics of the processes involved are discussed and explained by the introduction of the recombination centres with a capture cross-section of 2×10^{-15} cm^2 per hole (at 300°K).

539.2 : 537.311 : 621.382

20911 RECENT ADVANCES IN SILICON. N.B.Hannay.

Progress in semiconductors, Vol. 1 (London: Heywood. 1956) p. 1-35.

Reviews the state of knowledge to mid-1955 of silicon — its purification and preparation, the understanding of its properties, and the state of development of silicon devices. Sections deal with the preparation of high-purity material; crystal growing and zone-refining; physical chemistry of impurities; bulk properties; electrical and optical properties associated with impurity levels; properties of p-n junctions; and silicon devices. 156 references. J.B.Birks

539.2 : 537.311 : 621.3

20912 SILICON JUNCTION DIODES. D.E.Mason and D.F.Taylor.

Progress in semiconductors, Vol. 3 (London: Heywood. 1958) p. 83-116.

A review article with 20 references, containing much previo unpublished work. The theoretical behaviour of junction diodes - carrier flow in semiconductors and the properties of junctions, t behaviour of junction diodes, and theoretical aspects of silicon etching — is initially surveyed. The three main methods of producing junction diodes — grown-junction, alloyed junction, and impurity diffusion — are described, and heat treatment in silico and diode fabrication is discussed. The construction and charact istics of some typical silicon diodes, and their uses are reviewe J.B.Bi

539.2 : 537.311 : 53

CONDUCTIVITY OF MIXED ALKALI METAL CATHODES.
See Abstr. 19721

539.2 : 537.

20913 THE EFFECT OF PRESSURE ON MAGNETOELECT PROPERTIES OF BISMUTH.

S.S.Sekoyan and A.I.Likhter.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1940-2 (Aug., 1960). In Russia

The electrical conductivity, the Hall constant and the magnet resistance of bismuth monocrystals were measured as a function hydrostatic pressure up to 10 000 kg/cm^2. These measurements carried out at room temperature with the monocrystals lined up along one of the three principal orientations of the trigonal axis. was found that the carrier density fell by about 20% on applicatio 10 000 kg/cm^2. The anisotropy of the electron band structure of bismuth increased on application of pressure. A.Tybulew

539.2 : 537.311 : 621.

20914 ELECTRONIC PROCESSES IN CADMIUM SULPHIDE J.Lambe and C.C.Klick.

Progress in semiconductors, Vol. 3 (London: Heywood. 1958) p. 181-208.

A review paper with 70 references. The optical and electric properties of "pure" cadmium sulphide are surveyed including th position and shape of the fundamental absorption band, recombination luminescence, excitons, optical interaction with lattice vibrations, and conduction properties. The properties of imperfections in CdS are considered with reference to the behaviour of CdS as an extrinsic semiconductor, and as a photoconductor. Th luminescence of CdS is discussed in the final section. J.B.Birks

539.2 : 537.

20915 INFLUENCE OF ARSENIC PRESSURE ON THE DOPI OF GALLIUM ARSENIDE WITH GERMANIUM.

J.O.McCaldin and R.Harada.

J. appl. Phys., Vol. 31, No. 11, 2065-6 (Nov., 1960).

Suggests that the pressure of the more volatile element abov growing crystal of compounds of groups III-V elements may effec the distribution of impurity atoms between the sub-lattices. A simple estimate is given of the magnitude of the effect and some supporting qualitative results obtained with GaAs doped with Ge a described. D.G.Hollo

539.2 : 537.3

20916 RADIATIVE RECOMBINATION IN GALLIUM PHOSPH POINT-CONTACT DIODES.

H.C.Gorton, J.M.Swartz and C.S.Peet.

Nature (London), Vol. 188, 303-4 (Oct. 22, 1960).

p-type GaP crystals were grown from the vapour phase. Optical absorption measurements gave an energy gap of 2.19 eV a room temperature. Recombination radiation occurred near point contacts on GaP diodes under reverse bias; the energy of the radiation was between 1.96 and 2.19 eV with a peak at 2.12 eV. T reverse voltage characteristics exhibited discontinuities in the sl there being a correlation between the onset of luminescence at isolated points in the breakdown region and these discontinuities. J.Fra

539.2 : 537

20917 ELECTRICAL PROPERTIES OF N-TYPE InSb IN HIGH ELECTRIC FIELD AT 77°K. Y.Kanai.

J. Phys. Soc. Japan, Vol. 14, No. 10, 1302-8 (Oct., 1959).

The current–voltage character and Hall coefficient of n-typ InSb with different electron density were measured in a pulsive h tric field at 77°K. In a high electric field, impact ionization full band to conduction band occurred and the resistivity and coefficient decreased rapidly with increasing electric field. In same region of electric field, Hall mobility decreased and drift city reached a maximum value and then decreased. In the curve ie electron density versus μE^2, the rate of energy gain from tric field, there existed a critical value of μE^2 where the elec- density increased infinitely. This critical value of μE^2 in- ised with decreasing electron mobility at low field, and, in one ple, also increased with decreasing strength of the transverse netic field.

539.2 : 537.311

20918 THE GALVANOMAGNETIC PROPERTIES OF InSb SINGLE CRYSTALS DOPED WITH Te.

upprecht, R.Weber and H.Weiss.

aturforsch., Vol. 15a, No. 9, 783-94 (Sept., 1960). In German.

The variation of magnetoresistance of crystals of InSb with Te ing greater than 2×10^{16} cm^{-3} was measured as a function of ing, magnetic induction, and the angle between current and gnetic induction, at room temperature, 78° and 4.2°K. re is a very large difference in magnetoresistance which is ater when the current is parallel to the ⟨111⟩ growth direction n when the current flows at right angles to this direction. Hall ct measurements indicate that mixed conduction leads to the sotropy. In contrast to the magnetoresistance the electron mob- y is isotropic and the Hall coefficient is substantially constant h magnetic field. C.A.Hogarth

539.2 : 537.311

20919 INFRARED FARADAY ROTATION IN InAs AND InP.

I.G.Austin.

lectronics and Control, Vol. 8, No. 3, 167-9 (March, 1960).

Measurements were made at room temperature in fields up to kOe over a wavelength range of 2-17 μ. The values obtained for ctive electron mass, 0.043 m_0 in InAs with 10^{18} electrons per , and 0.10 m_0 for InP with 10^{17} electrons per cm^3, were higher n those obtained previously, and some explanation is given for . The dependence of rotation on wavelength and magnetic field n good accordance with the simple theory. C.Hilsum

539.2 : 537.311

20920 ON GALVANOMAGNETIC EFFECTS IN P-TYPE CRYSTALS OF PbTe.

K.Shogenji.

Phys. Soc. Japan, Vol. 14, No. 10, 1360-71 (Oct., 1959).

Measurements of the magnetoresistance and the planar Hall ct are described and an interpretation given of the electronic d structure of the crystal. The measurements were made at K as a function of the magnetic field strength and of the angle ween the magnetic field and the current through the specimen. coefficients relating to the galvanomagnetic effects were deter- ned from the experimental data. Using these coefficients the ctronic band structure of the crystal is shown to be {111} energy eroids, presumably prolate with a mass ratio of 0.3.

539.2 : 537.311

20921 ANOMALOUS HALL EFFECT IN $AgSbTe_2$.

R.Wolfe, J.H.Wernick and S.E.Haszko.

ppl. Phys., Vol. 31, No. 11, 1959-64 (Nov., 1960).

The Hall coefficient of the ternary semiconductor $AgSbTe_2$ r room temperature is positive in some specimens and negative others, although the Seebeck coefficient is always positive. The ative Hall coefficient decreases as the temperature is lowered n 180°K to 70°K and changes sign in lower temperatures. This ative Hall coefficient is associated with the presence in the $SbTe_2$ of a second phase consisting of Ag_2Te. The properties of two-phase material are interpreted in terms of the theory of transport properties of inhomogeneous semiconductors. In gle-phase $AgSbTe_2$ containing 3×10^{19} holes per cm^3, the hole bility is 35 cm^2/V sec at 300°K and it varies approximately as $^{0.6}$. [It has been suggested by Armstrong, Faust, and Tiller (Abstr. 202 of 1960) that the microstructure is associated with the sence of Sb_2Te_3 as a Widmanstätten precipitate along {111} planes the $AgSbTe_2$: This would indicate that none of the material was gle phase. Even though the Sb_2Te_3 in the measured specimens is sent in quantities too small to be detected in the present X-ray der photographs, it may have some effect on the measured perties. Therefore, the electrical properties of single-phase $SbTe_2$ have yet to be determined.] The lattice thermal conduc- ty is so low (0.0064 W cm^{-1} deg^{-1} C at 290°K) that the calculated "phonon mean free path" is less than the nearest neighbour distance. The thermal conductivity of a specimen rich in $AgSbTe_2-Ag_2Te$ eutectic is higher than that of either of the components. This excess thermal conductivity is attributed to circulating thermoelectric currents.

539.2 : 537.311

20922 GALVANO- AND THERMOMAGNETIC EFFECTS IN α-Ag_2Te.

S.Miyatani and I.Yokota.

J. Phys. Soc. Japan, Vol. 14, No. 6, 750-4 (June, 1959).

Nernst coefficient, magnetoresistance, and magnetothermoelectric power together with electrical conductivity, Hall coefficient, and thermoelectric power of α-Ag_2Te were measured as functions of the e.m.f. E of the galvanic cell $Ag|AgI|Ag_2Te|Pt$, where E may be considered to represent the relative position of the Fermi level in the Ag_2Te specimen. The experimental results exhibited consistent agreement with the Lorentz–Sommerfeld theory for degenerate two-band semiconductors with energy independent mean free paths of carriers. Relative thermal conductivity was also measured, showing a minimum at an E value expected from the theory.

539.2 : 537.311 : 621.382

20923 PROPERTIES OF THE III-V COMPOUND SEMICONDUCTORS.

F.A.Cunnell and E.W.Saker.

Progress in semiconductors, Vol. 2 (London: Heywood. 1957) p. 35-65.

The preparation, purification, energy band scheme, and general properties of the nine III-V compounds formed by combination of either Al, Ga or In, with either P, As or Sb are surveyed. 86 references. J.B.Birks

Photoconductivity

539.2 : 537.312

20924 INVESTIGATION OF PHOTOCONDUCTIVITY OF POWDERED SEMICONDUCTORS USING THE PHOTO-DIELECTRIC EFFECT.

Ya.A.Oksman and A.V.Burlakov.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1818-28 (Aug., 1960). In Russian.

Discusses conditions when the photodielectric effect can be related uniquely to photoconductivity of semiconducting powders in dielectric media. A technique and apparatus are described for measurements of the phenomenological characteristics of photoconductivity. A.Tybulewicz

539.2 : 537.312

20925 THE ROLE OF TRAPPING CENTRES IN RELAXATION OF PHOTOCONDUCTIVITY.

I.I.Boiko.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1835-40 (Aug., 1960). In Russian.

The decay curves of photoconductivity are discussed without assuming that the number of electrons in trapping-centre levels is small. It is shown that a study of the decay curves in their entirety gives important information on recombination and trapping.

A.Tybulewicz

539.2 : 537.312

20926 SENSITIZATION OF PHOTOCONDUCTIVITY IN GLASS BY DYES.

R.C.Nelson.

J. Opt. Soc. Amer., Vol. 50, No. 10, 1029 (Oct., 1960).

It has been found that a number of dyes, for example, pinacyanole, kryptocyanine and erythrosin, in the form of thin films on the surface, are able to sensitize a volume conductivity of glass. The spectral dependence of the resulting photoconductivity is identical with that of the dye used. The results appear to establish that sensitization of photoconductivity by dyes can take place in media having only local order, and for which electronic conductivity is otherwise unknown. A conductivity mechanism is considered. It is suggested that, if electronic conduction can be induced in Pyrex glass by dye sensitization, the same might be true of protein molecules or gels. K.N.R.Taylor

539.2 : 537.312

20927 ELECTRICAL PROPERTIES OF ALKALI ANTIMONIDES.

S.Imamura.

J. Phys. Soc. Japan, Vol. 14, No. 11, 1491-6 (Nov., 1959).

Systematic studies of the preparation procedures and the electrical characteristics of the alkali antimonides, such as sodium, potassium, rubidium and cesium antimonides, were carried out. It has been found that these antimonides can be classified into two groups, i.e. a group which transits, from p-type to n-type with successive activation, e.g. sodium and potassium antimonides, and a group which keeps constantly p-type, e.g. cesium antimonide. Rubidium antimonide was recognized to be an intermediate compound lying between these two groups. Supply of excess alkali metal, deposition of additional antimony and superficial oxidation gave remarkable effects on the dark photoconductivity and the photoemission, but these effects proceeded in opposite directions in these two groups. With decreasing temperature, the mobility of n-type compound decreased, whereas that of p-type one increased. A picture of impurity states in these compounds was proposed in order to interpret the above mentioned phenomena, taking the ionic radius of alkali atom and the crystal structure into consideration.

539.2 : 537.312

20928 PHOTOELECTRICAL PROPERTIES OF ALKALI ANTIMONIDES. S.Imamura.

J. Phys. Soc. Japan, Vol. 14, No. 11, 1497-1505 (Nov., 1959).

Photoemission, photoconduction and optical absorption of sodium, potassium, rubidium and cesium antimonides were studied at several stages in the course of preparation. In the former three, supply of excess alkali atoms caused the decrease in optical absorption and photoemission at the photon energies higher than the absorption edge, whereas in the last one these phenomena were not remarkable. Photoconduction characteristics were interpreted by assuming two impurity states (donor and acceptor) in each antimonide. Finally, two kinds of energy band structures in k-space were proposed on the basis of the crystal structures (cubic and hexagonal), using the energy values obtained from measurements.

539.2 : 537.312

20929 ON THE CHARACTER OF THE CONTACT FOR THE PHOTOVOLTAIC BARRIER EFFECT IN EVAPORATED CADMIUM SULPHIDE LAYERS.

G.Nadjakov, R.Andrejtschin, S.Balabanov and J.Stanislavova.

C.R. Acad. Bulg. Sci., Vol. 13, No. 1, 15-18 (Jan.-Feb., 1960). In German.

Three types of photovoltaic effect are distinguished, that due to a barrier caused by a metal semiconductor contact, that due to a p—n junction and that due to a contact potential. Experiments on cadmium sulphide crystals with two vacuum evaporated metal electrodes give evidence of ohmic contacts, one ohmic and one nonohmic contact and two non ohmic contacts. No clear correlation is found in contact changes between dark current-voltage characteristics and the photovoltage. G.F.J.Garlick

539.2 : 537.312

20930 THE CONTACT POTENTIAL PHOTOVOLTAIC EFFECT. G.Nadjakov and R.Andrejtschin.

C.R. Acad. Bulg. Sci., Vol. 13, No. 1, 19-22 (Jan.-Feb., 1960). In German.

Using two different metal contacts on a crystal and irradiating the whole volume of the crystal the contact photovoltaic effect can be separated from others. The nature of the individual contacts and particular design of cell is unimportant the effect being dependent only on the contact potential difference between the electrode metals (see also preceding abstract). G.F.J.Garlick

539.2 : 537.312

20931 ON THE CLASSIFICATION OF PHOTOVOLTAIC EFFECTS AND OF THE CONTACT POTENTIAL PHOTOVOLTAIC EFFECT. G.Nadjakov and R.Andrejtschin.

C.R. Acad. Bulg. Sci., Vol. 13, No. 2, 135-8 (March-April, 1960). In German.

The authors propose a classification to supersede that of Tauc (Abstr. 3097 of 1958) and distinguish the effects dependent on the nature of electrode contact from those which show independence of the contact (see also two preceding abstracts). G.F.J.Garlick

539.2 : 537.312

20932 QUENCHING EFFECT OF THE PHOTOCONDUCTIVITY DECAY IN CdS. M.Kikuchi and S.Iizima.

J. Phys. Soc. Japan, Vol. 14, No. 6, 856 (June, 1959).

Photoconductivity measurements were made on single crystal flakes of CdS, each equipped with an evaporated In and an Ag paste contact. The dependence of the amplitude and the decay time of the photocurrent on the voltage applied to these rectifying cells was determined. The long decay time, observed when a cell was biassed in the high resistance direction, could be considerably reduced by short circuiting the contacts for 10 sec during the decay. An ex ation is suggested in terms of the voltage dependence of the wid the barrier. P.J.

539.2 : 537

20933 INDUCED CONDUCTIVITY OF CdS BY β- AND γ-RA S.Ibuki.

J. Phys. Soc. Japan, Vol. 14, No. 9, 1196-1204 (Sept., 1959).

The β-rays were from 10 mc of Sr^{90} or from an accelerator the Van de Graaff type, and the γ-rays from 1 c of Cs^{137} or from 200 c of Co^{60}. The ohmic contact of the electrodes and the cryst uniformity were inspected, and some of the properties related to β- and γ-induced conductivity of the crystals compared with thos observed when the crystals were irradiated by visible light. It i concluded that the sample crystals grown by the author's method are uniform and that they have a low trap density and a high sens tivity to β- and γ-rays. It is shown that the elementary phenome of β- and γ-ray induced conductivity are quite similar to those i the case of visible-light irradiation, and that the number of electrons excited into the conduction band by a β-particle is about 10 times larger than that by a γ-ray of 1.3 ~ 1.5 MeV.

539.2 : 537.312 : 53

InAs AND InSb INFRARED DETECTORS. See Abstr.19499

539.2 : 537.

20934 P—N JUNCTIONS IN PHOTOSENSITIVE LAYERS OF PbS. V.F.Zolotarev and V.N.Larichev.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1741-50 (Aug., 1960). In Russi

Reports current—voltage characteristics of PbS layers, prepared by chemical precipitation or by vacuum deposition, and dependence of these characteristics on temperature and illumina P—N junctions were found in layers sensitized at high temperatu in air. A.Tybulew

539.2 : 537.

20935 HOLE MOBILITY AND CRYSTAL SIZE IN LEAD SULFIDE PHOTOCONDUCTIVE FILMS.

H.E.Spencer and J.V.Morgan.

J. appl. Phys., Vol. 31, No. 11, 2024-7 (Nov., 1960).

A correlation has been found between the size of the microcrystals in photoconductive lead sulphide films and hole mobility calculated from Hall, signal, and noise measurements. Films composed of larger microcrystals exhibit larger mobilities. Fie effect mobility as a function of frequency has also been measure The data indicate that the surfaces as well as the bulk of the film are p type. The lead sulphide-air interface of the films changes from exhaustion type to enhancement type as the film thickness increases.

539.2 : 537

20936 THE KINETICS OF PHOTOCONDUCTIVITY OF PHTHALOCYANINS. É.K.Putseiko.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 6, 1299-302 (June 21, 1960 In Russian.

Photoconductivity relaxation in the initial stages was observ by the taumeter method in thin (0.1 μ to a few μ) layers of phthalocyanin, with or without Cu and Mg, obtained by sublimatio in a high vacuum. The duration of photoelectric processes was found to be of the order 10^{-5} sec; for all phthalocyanins, the photoconductivity decay is of the recombination type and is repre sented by a simple hyperbolic relationship. F.Lach

539.2 : 537.312 : 535

20937 PHOTOCONDUCTIVITY AND LUMINESCENCE OF T F AND M CENTERS IN POTASSIUM CHLORIDE.

G.Kuwabara, A.Misu, T.Watanabe and Y.Nishiyama.

J. Phys. Soc. Japan, Vol. 14, No. 11, 1621-4 (Nov., 1959).

The photoconductivity and luminescence of additively colour KCl crystals by excitation with light in the F band were measure at room temperature as a function of the M centre concentration. With the growth of the M band, the photocurrent decreased, while the emission intensity increased. This result would suggest that for a crystal containing M centres the photoconductivity due to th F centre and the luminescence due to the M centre are the competing processes in the excited state of F centres.

539.2 : 537.

20938 A PHOTOELECTRIC ENERGY CONVERTER MADE POLYCRYSTALLINE SILICON.

A.Ya.Gliberman, A.K.Zaitseva and A.P.Landsman.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1751-4 (Aug., 1960). In Russia

olar batteries were made of p-type polycrystalline silicon,
—n junctions produced by thermal diffusion of phosphorus
r. Grids of closely-spaced current contacts avoided harmful
s of grain boundaries. The maximum power obtained from
illumination of 750 W/cm² intensity was only 5-6 W/cm², but
st of polycrystalline batteries was 2-3 times lower than that
nocrystalline converters. A.Tybulewicz

539.2 : 537.312

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PHOTOELECTRIC PROPERTIES OF ALLOY P—N JUNCTIONS IN SILICON CARBIDE.

G.F.Kholuyanov.

verdogo Tela, Vol. 2, No. 8, 1909-14 (Aug., 1960). In Russian.
lloy p—n junctions in α-SiC produced 1.2 V photo-e.m.f. at
when illuminated with ultraviolet radiation of 5mW/cm² inten-
The photo-e.m.f. peaks occurred at light energies of 4.3-4.5 eV.
increase of temperature the photo-e.m.f. curves were displaced
ds lower light energies and the forbidden gap width became
ler. At 20° C the maximum total sensitivity was 3×10^4 μA/W;
ensitivity rose with temperature because of reduction of the
resistivity. A.Tybulewicz

539.2 : 537.312

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PHOTOCONDUCTION AND DARKENING AgCl CRYSTALS AT LOW TEMPERATURES.

h and T.Suita.

ys. Soc. Japan, Vol. 14, No. 7, 894-901 (July, 1959).
Photocurrent of AgCl was measured using light and voltage
s of about 50 μsec duration between −150° and −50° C. Experi-
al results show that the lifetime of electrons has a minimum
een −80° and −110° C depending on the treatments of the
les. Darkening of the crystals was also measured at lower
eratures, showing that the darkenability increases with tempera-
higher than −80° C. The results were discussed with models con-
ng sensitivity centres and recombination centres and it seems
clear that the temperature dependence of the lifetime is
erned with the darkening properties of the crystals.

539.2 : 537.312

0941

DEMBER EFFECT IN SILVER CHLORIDE.

A.M.Goodman and G.Warfield.

. Rev., Vol. 120, No. 4, 1142-8 (Nov. 15, 1960).
The Dember effect (the appearance of a potential difference
een two faces of a crystal when radiation is incident on only one
was investigated in silver chloride using a chopped light—a.c.
lification system of measurement. The effect was resolved
a self-sustaining component which reaches a steady state (for
rticular wavelength and intensity of incident light) and a
elf-sustaining component which decays with time. The steady-
self-sustaining effect was found to be of only one polarity
mal polarity) when the illuminated face of the sample is coated
silver, but of both polarities when the illuminated face is not
ed. The normal or positive polarity self-sustaining effect
s up at a shorter wavelength and the inverse self-sustaining
t at long wavelengths, both in the vicinity of the optical absorp-
edge. A possible explanation for this behaviour based on the
tence of surface states is suggested. In the coated sample, the
al polarity effect was found to exhibit a peak at a wavelength of
t 0.383 μ at T = 88° K.

rmoelectric Properties

539.2 : 537.32

20942

ON THE THEORY OF THERMOELECTRICITY.

J.Tauc.

hys. Soc. Japan, Vol. 14, No. 9, 1174-5 (Sept., 1959).
The meaning of the inner electrical field in a two-band semi-
ductor, the gap of which depends on temperature, is discussed in
nection with the thermoelectromotive force.

539.2 : 537.32 : 621.382

0943

THEORY OF THE SEEBECK EFFECT IN SEMICONDUCTORS.

V.A.Johnson.

gress in semiconductors, Vol. 1 (London: Heywood, 1956).
3-97.
A detailed theoretical discussion, with comparison with expe-
ental data, of the thermoelectric power of semiconductors. The
tronic contribution in an impurity semiconductor includes
ice scattering, scattering by impurity ions, polar scattering,
ctive mass considerations, crystal orientation and anisotropy,
and additional aspects. The thermoelectric power in the transition and intrinsic ranges, and the phonon contribution are also discussed. 110 references. J.B.Birks

539.2 : 537.32

20944

BRIDGMAN EFFECT IN BISMUTH TELLURIDE CRYSTALS.

P.I.Baranskii and S.L.Tomkevich.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1714-22 (Aug., 1960). In Russian.

Deals with heat evolution or absorption on passage of an electric current through bismuth telluride p-type polycrystals. Heat evolution or absorption occurred in the regions where grain orientation altered from the direction parallel to the cleavage planes to the direction perpendicular to the cleavage planes. The proportionality between heat evolution and electric current identified the phenomenon with the Peltier effect at the junctions of these regions, known as the Bridgman effect (1928). The thermo-e.m.f. at these junctions was the product of the thermoelectric power and the temperature difference. A.Tybulewicz

539.2 : 537.32

20945

THE THERMOELECTRIC POWER OF PURE COPPER.

A.V.Gold, D.K.C.MacDonald, W.B.Pearson and I.M.Templeton.

Phil. Mag. (Eighth Ser.), Vol. 5, 765-86 (Aug., 1960).

Measurements of the absolute thermoelectric power S of very pure copper samples (with residual resistivity ratios as low as 3.1×10^{-4}) were carried out between ~0.1° and ~350° K. Several specimens were found to exhibit marked negative anomalies in S between 8° K and 9° K, whereas a very pure sample of "natural" copper gave small but positive values of S at low temperatures. By emphasizing that S depends on the relative importance of the various scattering mechanisms, it is shown that the anomalies occur whenever scattering by traces of iron becomes dominant, other impurities being of only minor importance. Moreover, one is able to account for the occurrences of similar anomalies, as well as the resistance minima, in dilute alloys of oxygen-containing copper with various solutes (e.g. Ga, Ge, Sn . . .) not in terms of these particular solutes directly, but only in so far as they separate traces of iron from its oxide, thereby bringing it into solid solution. At about 70° K, there is a positive peak in S, which is ascribed to an umklapp phonon-drag component.

539.2 : 537.32 : 536.2

20946

THERMAL CONDUCTIVITY AND VARIATION OF THE LORENTZ NUMBER OF PbSe WITH TEMPERATURE AND WITH THE DEGREE OF ELECTRON-GAS DEGENERACY.

E.D.Devyatkova and I.A.Smirnov.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1984-91 (Aug., 1960). In Russian.

The thermal conductivity and the thermoelectric power of p- and n-type samples, with carrier densities from 3.3×10^{17} to 9.6×10^{19} cm^{-3}, were measured between 90 and 440° K. The electronic part of the thermal conductivity agreed at all temperatures with the Wiedemann—Franz law, provided the chemical potential level was deduced from the thermoelectric power and provided r = 0; r is the power exponent in the dependence of the electron mean free path, l, on energy and temperature, and $l(T, \epsilon) = l_0(T)\epsilon^r$. The lattice thermal conductivity was the same for all samples. A.Tybulewicz

539.2 : 537.32

20947

THE EFFECTIVE MASS OF CARRIERS IN LEAD SELENIDE.

I.A.Smirnov, B.Ya.Moizhes and E.D.Nensberg.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1992-2005 (Aug., 1960). In Russian.

The thermoelectric power of PbSe was found to deviate from the theoretical formula in the impurity-conduction region (100-400° K) of n- and p-type samples with carrier densities from 3.3×10^{17} to 6.7×10^{18}cm^{-3}. This deviation was due to a temperature dependence of the effective carrier mass, which was also responsible for departures of the temperature dependences of the carrier mobilities from theoretical laws. Discussion of the energy-band structure of PbSe, PbS and PbTe led to relationships between changes in the effective carrier mass and changes of the forbidden gap width. A.Tybulewicz

539.2 : 537.32

20948

THERMOELECTRIC PROPERTIES OF THE INTERMETALLIC COMPOUND $MnAl_3$.

N.V.Kolomoets and E.A.Popova.

Ziz. tverdogo Tela, Vol. 2, No. 8, 1951-5 (Aug., 1960). In Russian.

The thermoelectric power, α, of $MnAl_3$ at room temperature ranged up to about +70 μV/deg. The negative sign of α at higher temperatures (the intrinsic-conduction region) indicated that the electron mobility was greater (> 200 $cm^2\ V^{-1}\ sec^{-1}$) than the hole mobility (≅ 200 $cm^2\ V^{-1}\ sec^{-1}$). Above 500°K the forbidden gap width was 0.58 eV, compared with 0.025 eV at room temperature.
A.Tybulewicz

539.2 : 537.32

20949 THERMOELECTRIC POWER OF AgCl

Y.Susuki, S.Endō and E.Haga.

J. Phys. Soc. Japan, Vol. 14, No. 6, 729-31 (June, 1959).

This was measured for AgCl doped with several concentrations of $CdCl_2$ and the results were compared with theory.

Dielectric Properties

539.2 : 537.2 : 532.7

20950 PERMITTIVITY AND DIELECTRIC LOSSES IN SOME POLAR SUBSTANCES UNDER THE INFLUENCE OF A CONTINUOUS ELECTRIC FIELD.

V.Petrescu, N.Babei, M.Antoniu and V.Vasilache.

Bul. Inst. Politeh. Iasi, Vol. 5(IX), No. 3-4, 199-204(1959). In Roumanian.

Methods are described for the measurement of permittivity and loss angle in polar dielectric substances. Influence of the electric field was studied for (a) liquid substances (castor oil) with the polarizing field applied simultaneously with the measuring field and (b) solid substances (represented by a series of benzene derivatives such as dinitrochlorbenzene and dinitrotoluene), where the molten substance was solidified by cooling in the electric field, and measurements were taken, without polarizing field, to find the remanent effect of the electric field. The following conclusions are reached: (1) for both cases a reduction is found in loss angle and permittivity; (2) this reduction is maintained with temperature (castor oil) and with frequency (solids), in the latter use the reduction being greater for tan δ at lower frequencies; (3) variation of tan δ and permittivity in castor oil with temperature show the existence of hysteresis cycles with or without the electric field being applied; (4) the existence of an external residual electric field could not be traced with solid polar substances for any state of polarization.
A.Reiss

539.2 : 537.2

20951 ON THE THEORY OF THE DIELECTRIC SUSCEPTIBILITY OF ANISOTROPIC MEDIA, POLARIZED WITH FINITE SPEED.

R.A.Suris and B.N.Finkel'shtein.

Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 2, 189-91; Disc. 212-13 (1960). In Russian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 1960). A previous theory (Abstr. 1091 of 1960) is extended to anisotropic dielectrics. A table shows the relation between the principal axes of the operator I (the eigenvalues of which determine the inverse relaxation times) and the crystal axes, and also the number of independent relaxation times, for different symmetry classes, when there is only one relaxation process.
R.Berman

539.2 : 537.2

20952 DIELECTRIC SUSCEPTIBILITY TENSOR OF [WURTZITE] CADMIUM SULFIDE.

T.Masumi.

J. Phys. Soc. Japan, Vol. 14, No. 9, 1140-2 (Sept., 1959).

The components of the static dielectric tensor $\|\kappa_{sij}\|$ are examined. An anisotropy of κ_s was found between the two crystal orientations $[2\bar{1}\bar{1}0]$ and [0001], which suggests explanations for the lattice vibration spectra of CdS and the scattering mechanisms of electrons in several semiconductors.

539.2 : 537.2

20953 PHOTODIELECTRIC PROPERTIES OF POLYCRYSTALLINE CADMIUM SELENIDE. I. HIGH TEMPERATURES.

Ya.A.Oksman and A.V.Burlakov.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1884-8 (Aug., 1960). In Russian.

The photodielectric effect of cadmium selenide powders in dielectric media was investigated above room temperature at frequencies not exceeding 200 kc/s. The effect was due to simple photoconductivity.
A.Tybulewicz

539.2 : 537.2

20954 FERROELECTRICITY AND THE STRUCTURE OF TRANSITION-METAL OXIDES.

L.E.Orgel.

Disc. Faraday Soc., No. 26, 138-44 (1958).

"Ions of the transition elements" Conference paper (see Abs 20727 of 1960). A study of the structural chemistry of the highe oxides of the A sub-group elements suggests that there is no sha transition from octahedral to tetrahedral stereochemistry but rather a slowly developing instability of the octahedral structur as the metal ion becomes "smaller". This leads successively to loosening of the metal ion at the centre of the octahedron, off-ce displacement characteristic of ferroelectrics and many other ox extensive displacement of oxide ions giving fivefold coordination and finally to tetrahedral coordination. "Size" in this context is to be identified with ionic radius, although it is closely related to It decreases roughly in the order Hf^{4+}, Zr^{4+}, Ti^{4+}, Nb^{5+}, Ta^{5+}, W, V^{5+}, Cr^{6+}, Mn^{7+} for ions exhibiting their group valency.

539.2 : 53

20955 A DYNAMIC THEORY OF DEFORMABLE IONIC LATTICES OF FERROELECTRIC CRYSTALS.

V.Kh. Kozlovskii.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1733-8 (Aug., 1960). In Russia

Properties of a ferroelectric crystal are investigated by expanding the potential energy of its ions into a power series (up the fourth power) of displacements along one of the coordinates. Free energy is found in terms of powers of polarization and defor mation. The possibility of phase transformations of first and sec type is discussed.
A.Tybulew

539.2 : 53

20956 STRUCTURES OF FERROELECTRIC DOMAINS IN TRIGLYCINE SULFATE.

H.Toyoda, S.Waku and H.Hirabayashi.

J. Phys. Soc. Japan, Vol. 14, No. 8, 1003-11 (Aug., 1959).

Studied by etching in various alcohols. Methyl alcohol etches the head of the polarization more readily than the tail, and gives, a relatively short time, clear domain patterns. This etchant etch the (001) surface very slowly and after a long time delineates the domain arrangement along the polarization axis. Domain boundar have cylindrical surfaces parallel to the b-axis but the sections perpendicular to the axis are quite indifinite in dimensions and direction. A domain terminated in a rounded tip in the antiparalle domain was observed. Crystal imperfection seems to have a cons erable effect on the domain structure of this crystal. Some prelim nary studies of domain wall motion under applied of electric fields are reported.

539.2 : 53

20957 DIELECTRIC PROPERTIES OF MIXED CRYSTALS OF BARIUM–STRONTIUM TITANATE.

S.Kisaka, S.Ikegami and H.Sasaki.

J. Phys. Soc. Japan, Vol. 14, No. 12, 1680-5 (Dec., 1959).

Mixed crystals of $(Ba, Sr)TiO_3$ containing up to about 10 mole of Sr were grown in the same triangular-plate shape as $BaTiO_3$ single crystals, and dielectric measurements were performed. U to 2.25 mole% Sr, the dielectric constant versus temperature (ε—T) curve near the cubic-tetragonal transition temperature maintains the same form as that of pure $BaTiO_3$, the peak value rising with increasing Sr content. Above 5.64 mole % Sr, however the ε—T curve has a rounded peak and the peak value drops remarkably. The temperature of maximum dielectric constant decreases with increasing Sr content at a constant rate of 2.9°C per mole% in spite of this change. The Curie—Weiss temperatur also drops with increasing Sr content at nearly the same rate, the difference between these two temperatures being held at about 20°C The Curie constant also seems to decrease slightly with increasin Sr content. A comparison between the effect of replacing Ba with Sr and the effect of hydrostatic pressure on the transition tempera ture and the lattice constant suggests that the transition temperature depends mainly on the lattice constant of the tetragonal c-axi

539.2 : 537.

20958 OPTICAL STUDIES ON THE EFFECT OF ELECTRIC FIELDS ON THE TRANSITIONS OF BARIUM TITANATE.

K.Kawabe.

J. Phys: Soc. Japan, Vol. 14, No. 12, 1755-65 (Dec., 1959).

The effect of electric fields on the three transition points of barium titanate was studied experimentally by observing the shift of the curve of the thermal transition of transparency with varying biasing fields. Transparent electrodes, thin films of stannic oxide, were used in order to observe the intensity of light transmitted through crystals to which electric fields were applied. The point is raised up to a critical temperature of 132°C, the red strength of the field being 9 kV/cm, and above this point ansition of the first order no longer takes place. From this the coefficient of P_z^4 in the Devonshire expression of the energy function is obtained, which supports the value ured by Drougard. The observed shifts of the Curie point he 5°C transition point are in good agreement with the values lated by using the Devonshire function of the sixth order. At 80°C transition, the experimental value is explained by g the terms of eighth and tenth powers of polarization to the Devonshire function. The relationship between the polariza- of a crystal and the intensity of the transmitted light is pointed n the case when the crystal is placed between crossed Nicols. arks are also given of the effects which the coating of electrodes pon the shape of the curve of the thermal transition of trans- ncy at the −80°C transition.

539.2 : 537.2

20959 RELAXATION POLARIZATION AND LOSSES IN ALKALI HALIDE SINGLE CRYSTALS. V.N.Lozovskii.
Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 2, 161-6; Disc. 167-9)). In Russian.

"1958 Moscow Dielectrics Conference". (See Abstr. 16003 of 1960). nines Lidiard's suggestion (Abstr. 5722 of 1955) that the broad- g of the frequency-loss peak can be explained by considering ly excited complexes. It is shown that the polarizability of ted complexes is greater than that of unexcited complexes and the perature-loss peak is then narrowed. This has been observed by kenridge (Abstr. 8723 of 1950) and Matsonashvili (Abstr. 10955 959). R.Berman

539.2 : 537.2

20960 ON THE ANOMALOUS DISPERSION OF n-PRIMARY ALCOHOLS. K.Asai.
hys. Soc. Japan, Vol. 14, No. 8, 1084-90 (Aug., 1959).

Mechanisms proposed for the dielectric anomaly observed in ow temperature form of n-primary alcohols are re-examined, special reference to the influence of the thermal history of mple. The slowly cooled sample gives the longer relaxation τ and a wider distribution of τ than the rapidly cooled one. activation energy for the dipole orientation depends upon the ber of carbons in the alcohol molecule. Results obtained are rent from those of previous investigators, but a reasonable el is obtained for this Debye-type abnormal dispersion.

539.2 : 537.2

20961 TEMPERATURE DEPENDENCE OF SURFACE VOLTAGE OF SILVER BROMIDE.
noike and H.Wakabayasi.
hys. Soc. Japan, Vol. 14, No. 12, 1664-70 (Dec., 1959).

The change in the surface voltage is due to the change in the c space-charge voltage between silver metal and silver bromide. r and on the free surface, silver ions and electrons move, and r surface levels change under the condition that their change cels the voltage change due to the ionic space-charge of this . The curve of surface voltage versus temperature was sured and consists of two straight lines, one referring to the urity region, and the other to the intrinsic region. The more the sample contains, the higher the temperature to which the e point moves. The formation energy of Frenkel defects and er quantities were obtained.

539.2 : 537.2

20962 CURRENTS IN ALKALI-HALIDE CRYSTALS CAUSED BY THE EMISSION OF ELECTRONS FROM A CATHODE DER POWERFUL ELECTRIC FIELDS. E.A.Konorova.
Akad. Nauk. SSSR, Ser. fiz., Vol. 24, No. 1, 58-65 (1960). In sian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 1960). cribes experiments with thin KBr crystals in which the currents ving immediately before breakdown were measured by a high- ed oscillograph. Fields up to 6 × 10^5 V/cm lasting from 50 to 0 microseconds could be applied. The resulting oscillograms reproduced. The temperature of the specimens was varied over range 20 to 200° C. In general much higher currents were ob- ved using pulse techniques than is normal with static measure- nts. Possible reasons for this are discussed.
A.E.I. Research Laboratory

539.2 : 537.2

20963 THE INVESTIGATION OF THE TEMPERATURE INFLUENCE ON ELECTRIC STRENGTH OF IONIC CRYSTALS. I. ONE-ELECTRON MODEL. V.D.Kuchin.
Bul. Inst. Politeh. Iasi, Vol. 5(IX), No. 1-2, 177-80 (1959).

Obtains the breakdown value of electric field by the criterion that the energy received by an electron from the field must exceed the energy lost to the lattice. Criticizes the theories of von Hippel, Fröhlich, and others. B.Meltzer

539.2 : 537.2

20964 PULSE BREAKDOWN OF SOLID DIELECTRICS. A.A.Vorob'ev and G.A.Vorob'ev.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 1, 75-83; Disc. 91-3 (1960). In Russian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 1960). A review is presented of breakdown characteristics under pulse conditions of different solid dielectrics. Experimental results are discussed from the point of view of the mechanism of breakdown. Z.Krasucki

539.2 : 537.2

20965 ELECTRIC BREAKDOWN OF MICA AT MICROWAVE FREQUENCY. T.Shibata, K.Masuda and T.Suita.
Technol. Rep. Osaka Univ., Vol. 9, 9-16 (March, 1959).

Ten kilovolt square pulses (3 kMc/s, p.r.f. 3000 $\sec^{-1}$) were used. It was found that: (1) the breakdown voltage is proportional to the sample thickness in the range above 10^{-3} cm (i.e, for the thicker samples the breakdown strength is constant); the breakdown strength below 10^{-3} cm is very large; (2) The breakdown voltage increases markedly when the pulse width is less than 10^{-5} sec; (3) the micro- wave breakdown voltage of mica is somewhat smaller than the d.c. breakdown voltage. A modified diffusion theory is proposed to explain the results.

539.2 : 537.2 : 532.7

DIELECTRIC BEHAVIOUR OF TWO PHASE MIXTURES.
See Abstr. 19147

OPTICAL PROPERTIES OF SOLIDS

539.2 : 535 : 536.48

20966 A CONTRIBUTION TO THE TECHNIQUE OF MEASURING THE OPTICAL CONSTANTS OF METALS AT LOW TEMPERATURES. V.G.Padalka and I N.Shklyarevskii.
Optika i Spektrosk., Vol. 9, No. 1, 119-21 (July, 1960). In Russian.

Decribes a cryostat suitable for low-temperature measurements of the optical constants of metals using one of the recently published polarization methods (1955-1958). The cryostat is in the form of a copper cylinder, fitted with windows. Samples are placed in this cylinder in such a way that they are in good contact with copper reservoirs in which liquid nitrogen is circulated. The sample posi- tions can be adjusted from outside and the cryostat can be evacuated down to 5 × 10^{-6} mm Hg. A.Tybulewicz

539.2 : 535 : 548

20967 CONTRIBUTION TO THE STUDY OF TITANIUM. II. OXIDES OF TITANIUM. C.Kurylenko.
Cahiers de Phys., Vol. 12, 163-74 (April, 1958). In French.

Data available on the physical properties of TiO, TiO_2, Ti_2O_3, and Ti_3O_5 are reviewed, the mineralogical, crystallographical, and optical properties of these oxides being summarized in tabular form. There are 21 references. (For Pt I see Abstr. 20595 of 1960).
G.I.W.Llewelyn

539.2 : 535

20968 INFRARED MAGNETOREFLECTION IN BISMUTH. I. HIGH FIELDS.
B.Lax, J.G.Mavroides, H.J.Zeiger and R.J.Keyes.
Phys. Rev. Letters, Vol. 5, No. 6, 241-3 (Sept. 15, 1960).

Interpretation of previous pulsed-field, infrared experiments on bismuth in terms of cyclotron resonance, gave values of effective mass which varied widely with magnetic field. An attempt to explain this variation in terms of non-parabolic bands does not agree with experiment. The experimental results can be explained in terms of interband transitions between magnetic levels of the valence and conduction bands. An energy band diagram is suggested for bismuth with zero field gap of 0.04 ± 0.005 eV at room temperature.
J.N.Hodgson

539.2 : 535

20969 INTERBAND MAGNETOREFLECTION IN BISMUTH. II. LOW FIELDS.

R.N.Brown, J.G.Mavroides, M.S.Dresselhaus and B.Lax.
Phys. Rev. Letters, Vol.5, No. 6, 243-6 (Sept. 15, 1960).

Magnetoreflection measurements on bismuth were carried out at liquid air temperatures and below, using fields up to 38 kG and wavelengths between 6 and 14 μ. The reflecting power for a fixed photon energy shows several oscillations when plotted as a function of H. The photon energies for several transitions were found from the reflecting power curves and plotted against H. The photon energies depend linearly on H and converge to the value 0.047 eV for H = 0.

J.N.Hodgson

539.2 : 535 : 532.7

THE REFRACTIVE INDICES OF LIQUID AND SOLID ARGON.

See Abstr. 19153

539.2 : 535

20970 POLARIZATION STUDY OF THIN SELENIUM FILMS.

R.Duverney.
J. Phys. Radium, Vol. 20, Suppl No. 7, 66A-75A (July, 1959).
In French.

The transmission of thin films of selenium at Brewster's angles depends very much on wavelength. This transmission is produced by the complex superposition of the multiple interferences which exist in each selenium film. The wavelength selectivity and high degree of polarization found by all observers is explained. The thickness of the films may be calculated in order to obtain the best polarization at a given wavelength (beyond 10 μ) with a reduced number of films. The transmission of the π component is not equal to one; an explanation, based upon the inhomogeneity in the thickness of each film, is proposed. The highest absorption observed (0.89 for 6 films at 10 μ) results from the transformation of red selenium into other varieties.

539.2 : 535 : 539.19

20971 A THEORETICAL CALCULATION OF THE BIREFRINGENCE OF POLYPROPYLENE CRYSTALS.

D.A.Keedy, J.Powers and R.S.Stein.
J. appl. Phys., Vol. 31, No. 11, 1911-15 (Nov., 1960).

In the source of some investigations on the effect of carbon—carbon and carbon—hydrogen bond polarizabilities on the optical properties of hydrocarbon polymers, a theoretical calculation of the polypropylene chain principal polarizabilities was performed. The polypropylene chain model given by Natta was used. Results were expressed in terms of carbon—carbon and carbon—hydrogen bond polarizabilities. Two sets of values of bond polarizabilities, one given by Denbigh, the other by Bunn and Daubeny, were substituted into the polarizability equation. Values of chain principal polarizabilities were then used to calculate the refractive index and birefringence using the Lorentz—Lorenz equation. Better agreement was found between experimental and theoretical birefringence values using Denbigh's data. Three explanations are suggested which might account for the differences between the two sets of bond polarizabilities.

539.2 : 535

20972 OPTICO-ACOUSTIC EFFECT IN CRYSTALS.

E.F.Gross, Ya.Ya.Abolin'sh and A.A.Shultin.
Zh. tekh. Fiz., Vol. 28, No. 10, 2255-8 (1958). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 3, No. 10, 2070-2 (Oct., 1958).

When a strong white light beam, chopped at 150-250 c/s, was passed through an alum crystal, mechanical vibrations at the same frequency were observed. If a Rochelle salt crystal was used piezoelectric charges were detected.

T.S.E.Thomas

539.2 : 535

20973 THE ELECTRO-OPTICAL EFFECT IN CRYSTALS.

I.S.Zheludev and O.G.Vlokh.
Kristallografiya, Vol. 3, No. 5, 639-51 (Sept.- Oct., 1958). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 3, No. 5, 647-60 (Dec., 1959).

The authors review recent work on the changes produced in the optical properties of some crystals (notably ammonium dihydrogen phosphate) under the influence of an electric field. A phenomenological description of both the linear and quadratic dependence on the field is given and the relation of the former to the piezoelectric effect and of the latter to electrostriction is discussed. Since materials exhibiting large piezoelectric and electrostriction effects are usually ferro- and antiferroelectrics it is c cluded that the electro-optic effect must be closely related to fer electricity. Although the effect is not thoroughly understood, sev ral possible practical applications are described: an adjustable narrow-band polarized-light interference filter, a sound-modulat light beam for recording on cine film, an accurate method for measuring distances up to 50 km, high-voltage measurements in the kilovolt range, and a high-frequency optical shutter.

I.Co

539.2 :

20974 RAMAN SCATTERING OF LIGHT NEAR PHASE TRANSITION POINTS OF THE SECOND KIND.

V.L.Ginzburg and A.P.Levanyuk.
Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 192-6 (July, 1960).
In Russian.

The spectral composition of light scattered in crystals near phase transition points of the second kind is studied (quartz and ferroelectrics). It is shown that the "critical opalescence", whic occurs with the approach to the critical Curie point, is closely related to the Raman scattering of light.

539.2 : 535

20975 THIN-LAYER OPTICS. V. PROPERTIES OF SILICO

M.P.Lisitsa and N.G.Tsvelÿkh.
Optika i Spektrosk., Vol. 7, No. 4, 552-7 (Oct., 1959). In Russian

For Pt IV, see Abstr. 7993 (1960). Transmission and reflect coefficients of sublimated amorphous silicon layers, 0-1200 A thi were measured. Dependence of the light energy absorbed in a lay on its thickness was obtained and the refractive index of thicker layers was found. The process of ageing is discussed.

A.Tybulew

539.2 : 535

20976 LOCALIZED MODES IN CRYSTALS AND SHARP DETAILS OF THE OPTICAL ABSORPTION SPECTRA

R.Englman.
Phil. Mag. (Eighth Ser.), Vol. 5, 691-5 (July, 1960).

A theory is put forward in qualitative terms to account for th sharp nibs frequently observed at the long wavelength end of the spectral lines of ionic crystals, in which optical absorption by a cation has taken place. The broad band is primarily due to excita tion of the vibrational modes of the crystal by the Franck—Condo strain; nibs are supposed to be caused by localized modes introdu in the crystal either by the differing mass or by a change in the force constants of the absorbing ion. Experimental evidence in rocksalt-type crystal indicates the presence of T_{2g}-modes of loc ized vibrations.

539.2 : 535

20977 OPTICAL ABSORPTION IN THE DIVALENT OXIDES OF COBALT AND NICKEL. W.P.Doyle and G.A.Lo

Disc. Faraday Soc., No. 26, 27-33 (1958).

"Ions of the transition elements" Conference paper (see Abs 20727 of 1960). The absorption spectra of cobaltous and nickelou oxides were determined between 200 and 1000 mμ by transmissio through thin films and between 360 and 1000 mμ by the technique pressed potassium bromide disks. The first maxima in the film spectra, at 5.9 eV for cobaltous oxide and 4.4 eV for nickelous oxide, are interpreted as exciton transitions and the second maxi in nickelous oxide, at 5.2 eV, is attributed to the transition to the conduction band. The pressed disk spectra are discussed in terr of crystal field theory. It was not found possible to prepare thin films of ferrous oxide.

539.2 : 53

20978 THE LINE SPECTRA OF Cr^{3+} ION IN CRYSTALS.

S.Sugano and Y.Tanabe.
Disc. Faraday Soc., No. 26, 43-8 (1958).

"Ions in transition elements" Conference paper (see Abstr. 20727 of 1960). The line spectra of ions of the transition elemen in crystals offer many interesting problems, among which the el tronic origin of the line spectra seems to be the first problem to attacked. This problem is treated here for Cr^{3+} impurities in Al (ruby), and assignments are made for the characteristic doublets R_1, R_2 (~ 14 400 cm^{-1}) and B_1, B_2 (~ 21 000 cm^{-1}) of ruby. The difficulties for Cr alums are discussed in comparison with ruby.

539.2 : 535.33

0979 ABSORPTION LINES OF Cr^{3+} IN RUBY.

W.Low.

ıem. Phys., Vol. 33, No. 4, 1162-3 (Oct., 1960).

New lines were found at 14 795, 14 950, and 15 178 cm^{-1}. These
have been identified as belonging to the $^2F_1$ triplet. Similarly,
e at 21 352 cm^{-1} has been assigned to the $^2F_2$ triplet. It is
n that these levels originate from the ^2G and ^2D levels, respec-
y, with considerable admixture from the ^2H level.

539.2 : 535.33

980 CRYSTAL SPECTRA OF CHROMIUM TRIS-ACETYL ACETONE.

A.Chakravorty and S.Basu.

ıem. Phys., Vol. 33, No. 4, 1266 (Oct., 1960).

Recent paramagnetic resonance studies (Abstr. 4387 of 1958)
ved that in chromium tris-acetyl acetone, the t_{2g} levels were
by the presence of a trigonal crystal field superimposed on a
c field. This has now been directly confirmed by a study of the
rption spectrum using polarized light; as expected two bands
obtained with peaks at 555 and 585 mμ. W.J.Orville-Thomas

539.2 : 535.33

0981 OPTICAL MEASUREMENT OF THE PLASMA FREQUENCY AND $M_{2,3}$ BAND OF CHROMIUM.

.Axelrod and M.P.Givens.

s. Rev., Vol. 120, No. 4, 1205-7 (Nov. 15, 1960).

The transmission of thin chromium films was measured in the
eme vacuum ultraviolet. The onset of transmission at 500 A or
eV agrees well with the theoretical prediction by Pines of
V; it also agrees well with the experimental electron eigenlosses
sured by Watanabe, and by Marton and Leder, of 26 and 22 eV,
pectively. The $M_{2,3}$ band was also measured.

539.2 : 535.33

0982 ABSORPTION OF LIGHT BY CUPROUS OXIDE FILMS.

I.S.Gorban' and V.B.Timofeev.

. tverdogo Tela, Vol. 2, No. 6, 1111-14 (June, 1960). In Russian.

General features of the absorption spectrum of thin (~1 μ) and
assive" Cu_2O specimens are reported to be the same
0 < λ < 6900 A). However, thin films do not exhibit any appreci-
luminescence. S.Chomet

539.2 : 535.33

20983 EXCITON ABSORPTION OF LIGHT IN Cu_2O CRYSTALS. I. THE CASE OF ABSENCE OF CONSTANT EXTERNAL LDS.

S.A.Moskalenko.

. tverdogo Tela, Vol. 2, No. 8, 1755-65 (Aug., 1960). In Russian.

Group theory is used to classify electron, hole and exciton bands
u_2O at various points of the k-space. The mechanism of exciton
itation is discussed and the theoretical conclusions are compared
n experiment. A.Tybulewicz

539.2 : 535.33

20984 RADIATIVE RECOMBINATION IN GERMANIUM [SINGLE] CRYSTALS BOMBARDED BY FAST ECTRONS.

V.S.Vavilov, A.A.Gippius, M.M.Gorshkov and
).Kopÿlovskii.

. eksper. teor. Fiz., Vol. 37, No. 1(7), 23-6 (July, 1959). In
ssian. English translation in: Soviet Physics—JETP (New York),
l. 37(10), No. 1, 15-17 (Jan., 1960).

Data are presented on the infrared spectrum accompanying
recombination of electrons and holes. It is shown that with
reasing concentration of Frenkel defects caused by fast-electron
nbardment, the relative intensity of the emission band with a
ak at 2.35 μ also increases.

539.2 : 535.33

20985 THE ABSORPTION SPECTRA OF SOLID HYDRATED NICKEL SULPHATE.

H.Hartmann and H.Müller.

c. Faraday Soc., No. 26, 49-52 (1958).

"Ions in transition elements" Conference paper (see Abstr.
727 of 1960). In order to test Hartmann and Furlani's quantum-
chanical calculations of the energy level diagram of the complex
. $Ni(H_2O)_6^{2+}$ for octahedral and tetragonal symmetry, the spectra
the crystalline hexa- and heptahydrates of nickel sulphate were
ermined at room temperature and at -205° C. The number and
uence of main and intercombination bands satisfy the require-
nts of the theory. Distortion of the octahedral symmetry of the
mplex ion is shown by the splitting of the main bands. The extent of distortion can be deduced from the relative displacement of the absorption curve. The spectrum suggests the occurrence of multiplet splitting of the triplet terms.

539.2 : 535.33

20986 EVIDENCE FOR INTERNAL ROTATION IN THE FINE STRUCTURE OF THE INFRARED ABSORPTION OF OXYGEN IN SILICON.

H.J.Hrostowski and B.J.Alder.

J. chem. Phys., Vol. 33, No. 4, 980-90 (Oct., 1960).

Interpretation of the spectra of silicon saturated with oxygen highly enriched with O^{18} confirms that oxygen is located in an interstitial site. The over-all features of the absorption indicate that the oxygen is in a nonlinear Si_2O configuration. The fine structure in the asymmetric Si—O stretching vibration and its temperature dependence can be largely explained by motion of the oxygen in a potential barrier with six-fold symmetry. A symmetry analysis of this process predicts additional structure some of which has now been observed under higher resolution. The spectra of oxygen contaminated silicon containing 2% germanium corroborate the authors' explanation of the fine structure. The potential barrier hindering rotation of the oxygen about the axis joining its two bonded silicons is ascribed to the surrounding silicon lattice. Calculation of the potential shows that as the oxygen rotates it can also wobble. Since the fine structure indicates that the ground state splitting due to rotation is near 2 cm^{-1}, the barrier hindering rotation is about 200 cal/mole. Calculation of this barrier then indicates that the maximum wobble angle is 0.2° and the Si—O—Si angle near 150°.

539.2 : 535.33

20987 VIBRATIONAL SPECTRUM OF CRYSTALLINE POTASSIUM HYDROXIDE.

R.G.Snyder, J.Kumamoto and J.A.Ibers.

J. chem. Phys., Vol. 33, No. 4, 1171-7 (Oct., 1960).

The infrared spectrum of KOH was obtained in the region 4000-300 cm^{-1}. At 23° C the spectrum shows two broad bands, one at 3600 cm^{-1} and the other at 643 cm^{-1}. At -180° C the O—H stretching band near 3600 cm^{-1} appears as a doublet. Splitting is shown to arise from coupling between the two OH^- ions in the unit cell. Evidence is presented that indicates a small difference in the strengths of the hydrogen bonds in KOH and KOD. The first overtone of the O—H stretching band is found at 6868 cm^{-1} and from this a value of $\omega_e x_e$ of 110 ± 11 cm^{-1} is derived for KOH at -180° C. The 643 cm^{-1} band of KOH at 23° C is identified as a librational fundamental. At -180° C this band appears at 709 cm^{-1} together with bands at 840 and 671 cm^{-1}; these latter two bands are also identified as librational modes. These librational frequencies lead to a considerably higher barrier to rotation of the OH^- ions in KOH than in $Mg(OH)_2$ or $Ca(OH)_2$. This higher barrier is probably the result of the weak hydrogen bonding in KOH. Spectra of KOH—KOD mixtures are interpreted in terms of relatively small coupling between the librational modes of the hydroxyl ions and between the librational and translational modes.

539.2 : 535.33

20988 STIMULATED OPTICAL RADIATION IN RUBY.

T.H.Maiman.

Nature (London), Vol. 187, 493-4 (Aug. 6, 1960).

When the material is irradiated at about 5500 A the chromium ions are excited to the $^4F_2$ state and then quickly undergo nonradiative transitions to the ^2E state. Under intense excitation at 5500 A a negative temperature may be set up in the ^2E state and stimulated emission at 6943 A may be observed between this and the ground state. J.M.Baker

539.2 : 535.33

20989 THE ANISOTROPY OF OPTICAL ABSORPTION INDUCED IN SAPPHIRE BY NEUTRON AND ELECTRON IRRADIATION.

E.W.J.Mitchell, J.D.Rigden and P.D.Townsend.

Phil. Mag. (Eighth Ser.), Vol. 5, 1013-27 (Oct., 1960).

Measurements were made of the anisotropy of the optical absorption induced by neutron and electron irradiation. Some of the measurements were made with a six-plate fluorite polarizer, whose efficiency was found to be 65% at 2500 A, and which could be used at shorter wavelengths than a Glan—Thomson prism. In the spectrum induced by neutron irradiation, bands were resolved at -185°C at 1.9, 2.2, 2.8, 3.5, 4.1, 4.8 and 6.1 eV, the latter being measured both with a quartz spectrophotometer and a fluorite vacuum spectrograph. The 6.1 eV band was found to be isotropic but the 2.8, 3.5, 4.1 and 4.8 eV bands were anisotropic, having parallel to perpendicular ratios greater than 1. The anisotropy measurements reveal the presence of a band of opposite anisotropy at 5.3 eV. In order to account for the complete shape of the spectrum of the anisotropic ratio it is necessary to assume the presence of other bands having the same anisotropy as the 5.3 eV band. The 5.3 eV band did not appear in the electron irradiated specimens. although both the 4.8 ($\mu_{\parallel} < \mu_{\perp}$) and 6.1 eV (isotropic) bands were found. Possible models for these two centres are discussed. The rate of decrease of absorption with heat treatment was measured for temperatures up to 500°C and is compared with the rate of recovery of the neutron induced expansion studied by Martin (1959).

539.2 : 535.33 : 537.3

20990 THE EFFECT OF ANNEALING ON THE ABSORPTION SPECTRA AND THE ELECTRICAL CONDUCTIVITY OF NaCl:Pb AND KCl:Pb CRYSTAL PHOSPHORS.

I.Ya.Melik-Gaikazyan, E.K.Zavadovskaya and M.N.Treskina.
Optika i Spektrosk., Vol. 9, No. 1, 83-5 (July, 1960). In Russian.

Reports an investigation of the effect of 600°C annealing on the absorption spectra and the ionic conductivity of KCl and NaCl activated with lead. The absorption spectra had a band at ~210 mμ (due to impurity ions at special locations, such as interblock surfaces) and a band at ~273 mμ (due to impurity ions at lattice sites). The ionic conductivity was related to the intensity of the 273 mμ absorption band. Five- to twenty-hour annealing of NaCl:Pb, or five- to ten-hour annealing of KCl:Pb, enhanced the intensity of both absorption bands and raised the electrical conductivity. In the case of KCl:Pb, twenty-hour annealing reduced strongly the intensity of the 210 mμ band, produced a third activator band at 250 mμ (probably due to the formation of a new chemical compound, e.g. $PbCl_4$ or $PbCl_6$), but did not affect the 273 mμ band intensity or the electrical conductivity. Annealing of both crystals for fifty or seventy hours made their absorption spectra identical with PbCl (due to recrystallization) and reduced their electrical conductivity. A.Tybulewicz

539.2 : 535.33

20991 THE ABSORPTION SPECTRUM OF VANADIUM CORUNDUM. M.H.L.Pryce and W.A.Runciman.

Disc. Faraday Soc., No. 26, 34-42 (1958).

"Ions of the transition elements" Conference paper (see Abstr. 20727 of 1960). A crystal of Al_2O_3(V) was studied in absorption over the wavelength range 0.4-1.2 μ. Measurements were made at 4.2, 20 and 77°K, and polarization spectra obtained in the visible region. Two absorption bands were resolved into finer structure than had been previously reported, and one of the components was further split by a magnetic field. The relevant crystal field theory for two d-electrons in a trigonal field is developed, using an octahedral field to provide a preliminary classification of states. The main features of the spectra are discussed in terms of this theory and possible complications due to Jahn–Teller distortions are considered.

539.2 : 535.33

20992 ABSORPTION OF ULTRA-VIOLET AND VISIBLE LIGHT BY ULTRA-THIN SECTIONS OF VITRINITE FROM A HIGH-VOLATILE BITUMINOUS COAL.

S.Ergun, J.T.McCartney and R.E.Walline.
Nature (London), Vol. 187, 1014-15 (Sept. 17, 1960).

Ultra-thin sections of vitrinite cut with a diamond knife are examined for absorption in the region 2000-6000 A. Extinction coefficients are computed and plotted. The section thicknesses are of the order of 550 A. The high absorption in the visible is reported and discussed in relation to chemical structures. The results are consistent with X-ray diffraction data. S.Tolansky

539.2 : 535.37

20993 IMPURITY FLUORESCENCE IN CRYSTALS.

Yu.E.Perlin.
Fiz. tverdogo Tela, Vol. 2, No. 8, 1915-27 (Aug., 1960). In Russian.

A theory of resonance fluorescence of atoms is generalized to electrons localized near lattice defects and interacting with the phonon field. It is shown that the excitation curve of fluorescence coincides with the curve of optical absorption by impurities. The fluorescence band is displaced towards the red end with respect to the impurity absorption band and is a mirror image of the latter (the line of symmetry passes through the purely electronic transition). Experimental data on the infrared fluorescence of colour centres in alkali-halide crystals showed reasonable agreement with the theory. See also following abstract. A.Tybulewicz

539.2 : 53

20994 ALLOWANCE FOR RADIATIONLESS TRANSITIONS THE THEORY OF IMPURITY FLUORESCENCE.

Yu.E.Perlin.
Fiz. tverdogo Tela, Vol. 2, No. 8, 1928-35 (Aug., 1960). In Russ

The author's resonance fluorescence theory (see preceding abstract) is extended to the case when weak interactions of loca electrons with acoustical lattice vibrations may produce radiati transitions from the excited virtual state. It is shown that the r nance theory still applies but the quantum yield of fluorescence less than unity. The temperature dependence of the quantum yi deduced. A.Tybule

539.2 : 5

20995 EFFECT OF MOLECULAR WEIGHT ON THE LUMI NESCENCE OF POLYMERS. V.F.Gachkovskii.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 6, 1358-60 (Aug. 21, 1960). In Russian.

Fluorescence spectra of polyphenylacetylenes, polystyrenes polymethacrylates, many proteins, aminoacids, nucleic acids D and RNA etc. disclose a continuum (300-700 mμ) with constant maxima in the red portion and a broad diffuse maximum in the blue—violet portion, the position and form of the latter varying one compound to another and with the molecular weight. For po phenylacetylenes the increase of molecular weight causes a red shift of the diffuse maximum and a drop in its intensity. Simila phenomena were observed with polystyrenes. F.Lach

539.2 : 535.37 :

NEW CONSTANT-BRIGHTNESS PHOSPHORS. See Abstr. 18589

539.2 : 535.37 :

A NEW MEASURING SYSTEM FOR QUANTUM EFFICIENC MEASUREMENTS OF LUMINESCENT SUBSTANCES. See Abstr. 19393

539.2 : 53

20996 THE MECHANISM OF THE RECOMBINATION LUMINESCENCE OF ACTIVATED ALKALI HALIDE CRYSTALS.

Ch.B.Lushchik, G.G.Liid'ya, I.V.Yaek and É.S.Tiisler.
Optika i Spektrosk., Vol. 9, No. 1, 70-6 (July, 1960). In Russian.

Reports the results of an investigation of the recombination luminescence (due to recombination of electrons and holes) and photochemical transitions (optical bleaching) in KCl, KBr and KI crystals activated with Ga^+, Ge^{2+}, In^+, Sn^{2+}, Tl^+ and Pb^{2+}. The crystals were excited with X-rays and light in the regions of exc and activator absorption bands and of "band—band" transitions. role of electron, hole, exciton and sensitization processes is dis and illustrated by excitation, luminescence, thermoluminescence optical flash stimulation, optical and thermal bleaching spectra. A.Tybule

539.2 : 535

20997 OPTICAL STUDIES ON THALLIUM-ACTIVATED ALKALI-IODIDE CRYSTALS. Y.Uchida and R.Kato

J. Phys. Soc. Japan, Vol. 14, No. 10, 1408-14 (Oct., 1959).

Absorption and emission spectra of KI:Tl and NaI:Tl phosph were investigated at both room and liquid air temperatures. In order to perform optical measurements on NaI:Tl, special care taken to prevent the crystal surface from being clouded by mois In the absorption spectra of NaI:Tl, new bands due to the presen of thallium were found. Their maximum absorption coefficients seemed to vary with the square of the thallium concentrations. Similar behaviour has already been found by Yuster and Delbecq (Abstr. 5391 of 1953) in their investigation on KI:Tl. In emissio both KI and NaI crystals containing high concentrations of thalli showed a subsidary band overlapping the short-wavelength tail o the known main band. The relations between these absorption a emission bands was investigated and a discussion is given in ter of an extended model proposed by Seitz (1938).

539.2 : 53

20998 TRANSFER OF EXCITATION ENERGY IN SOLID SOLUTIONS OF ANTHRACENE—POLYSTYRENE AN 9,10-DIPHENYLANTHRACENE—POLYSTYRENE.

L.J.Basile and A.Weinreb.
J. chem. Phys., Vol. 33, No. 4, 1028-36 (Oct., 1960).

The transfer of excitation energy from the excited solvent t the solute was studied as a function of solute concentration for solutions of anthracene and 9,10-diphenylanthracene in polyne. Transfer efficiencies and fluorescence spectra were ied for both systems. The fluorescent light pulse of both ms, when excited by electrons and u.v. radiation, was recorded nalysed. Results indicate that radiative transfer predominates v solute concentration, while at higher solute concentration ansfer process is predominantly nonradiative. Differences ≥en the two systems are probably due to anthracene being ically bound to the polymer chain while 9,10-diphenylanthracene t.

539.2 : 535.37

)999 POLARIZATION OF THE EDGE EMISSION IN CdS.

R.J.Collins and J.J.Hopfield.

. Rev., Vol. 120, No. 3, 840-2 (Nov. 1, 1960).

The edge emission spectra of CdS was examined in the temperarange 70°-150° K. In this interval the ratio of the intensity of ıght emitted whose plane of polarization is perpendicular to the is of the crystal to that parallel to the c-axis was determined. ratio $I_{\perp}/_{\parallel}$ decreased with increasing temperature. In agree- with an earlier paper (Abstr. 10804 of 1959), assigning the sion as the recombination of a trapped hole and free electron, iterpretation is offered in terms of the splitting of the ground of the centre. The splitting is caused by the presence of the tal field in a manner similar to that observed for the valence . However, from the present experiment alone an equally sfactory explanation can be offered in terms of the recombination trapped electron with holes possessing a thermal distribution ng the valence band levels. In either case a splitting of 0.014 eV is obtained.

539.2 : 535.37

000 TENTATIVE INTERPRETATION OF THE PHOTOLUMINESCENCE EMISSIONS OF COPPER IODIDE AT TEMPERATURES.

S.Nikitine and R.Reiss.

hys. Radium, Vol. 20, No. 7, 718-19 (July, 1959). In French.

The experimental data previously reported by the authors on ıbsorption and photoluminescence spectra of CuI at 4° and are summarized. An energy level scheme is proposed lving exciton formation and thermal excitation at 77° K.

J.B.Birks

539.2 : 535.37

1001 AN ANALYSIS OF THE FLUORESCENCE SPECTRUM OF EUROPIUM ETHYL SULPHATE.

B.R.Judd.

ecular Phys., Vol. 2, No. 4, 407-14 (Oct., 1959).

A theoretical analysis is made of the splittings induced in the ls $^7F_1$, $^7F_2$, $^7F_3$, $^7F_4$, $^7F_5$, $^7F_6$ of the ion Eu^{3+} by the electric l of the ethyl sulphate lattice. Four parameters are used to fit data, and it is found that very good agreement can be established veen experiment and theory in the great majority of cases. parameters are compared to the corresponding ones for other e earth ethyl sulphates. A reason is given for the absence of a gnetic dipole character in the transition $^5D_1 \rightarrow {}^7F_1$.

539.2 : 535.37

21002 EMISSION SPECTRUM OF TRIVALENT HOLMIUM IN THE SCHEELITE STRUCTURE.

.Van Uitert and R.R.Soden.

hem. Phys., Vol. 33, No. 5, 1532-4 (Nov., 1960).

Fluorescent emission due to holmium can be readily observed . calcium tungstate host lattice under 3660 A excitation. There at least eight excited states of holmium which fluoresce in the ble range due to transitions to the $^5I_8$ ground state. These ssion peaks show concentration quenching effects which appear e due to the development of exchange coupling. A number of ssion peaks due to holmium represent transitions which do not respond to known absorption bands. These peaks are particularly minent in the emission spectra at high concentrations of holmium.

539.2 : 535.37

1003 THE EFFECT OF IMPURITIES ON LUMINESCENCE OF CRYSTALLINE NAPHTHALENE.

Г.Shpak and E.F.Sheka,

ika i Spektrosk., Vol. 9, No. 1, 57-63 (July, 1960). In Russian.

Reports an investigation of the effect of temperature and solute purity) concentrations on the luminescence and absorption ctra of solid solutions of α- and β-methylnaphthalenes and of and β-naphthols in crystalline naphthalene at 20.4°, 77° and 200° K. results showed that the solute molecules produced two types of inescence centre in the naphthalene lattice.

A.Tybulewicz

539.2 : 535.37

21004 LUMINESCENCE OF KI:Tl INDUCED BY FAR ULTRA-VIOLET LIGHT.

M.Ueta and T.Ishii.

J. Phys. Soc. Japan, Vol. 14, No. 6, 857-8 (June, 1959).

A graph for the quantum yield under excitation in the range 4 to 8 eV is given for KI containing 0.3% Tl. Peaks of emission at 4.3 and 5.2 eV correspond to direct excitation of Tl, and minima at 5.7 and 6.6 eV are due to absorption maxima in the KI crystal. The results are similar to those of Teegarden (unpublished) for KI with 0.001% Tl. The quantum efficiency is ~0.8 below 1750 A (7 eV).

S.T.Henderson

539.2 : 535.37

21005 LUMINESCENCE PROCESSES IN THE KCl:Tl PHOSPHOR IN A MULTIDIMENSIONAL CONFIGURATION SPACE.

H.Kamimura and S.Sugano.

J. Phys. Soc. Japan, Vol. 14, No. 11, 1612-21 (Nov., 1959).

In order to explain the 3050 A and 4750 A emissions of KCl:Tl phosphor which are raised by excitation in any of the absorption bands, a multi-dimensional configuration coordinate model is introduced. This is achieved by taking into account the Jahn–Teller effect for the excited states of the thallium ion. The Jahn–Teller effect is treated by means of an intermediate coupling scheme within the 6s6p configuration, because the mixing of the ^3P and ^1P states by the spin–orbit interaction is essential to understand the optical properties. It is shown that introduction of a tetragonal distortion of the emission centre is able to explain the luminescence processes of this phosphor both semi-quantitatively and qualitatively: under the tetragonal and trigonal distortions, both the crossing of the pure spin singlet ^1P and triplet ^3P curves and the appearance of two minima in the $^3P_1$ energy curves are expected. The former accounts for the non-radiative transition from the $^1P_1$ state to the $^3P_1$ state and the latter for the two emission bands. The two types of distortion are equally able to give semi-quantitative agreement of the relative strengths of the absorption and emission bands with experiments, but only the tetragonal distortion explains the polarization of the 3050 A emission observed. Finally the model of Johnson and Williams is criticized.

539.2 : 535.37

21006 FLUORESCENCE AND REFLECTION SPECTRA OF NaI SINGLE CRYSTALS.

W.J.Van Sciver.

Phys. Rev., Vol. 120, No. 4, 1193-1205 (Nov. 15, 1960).

The fluorescence emission and excitation, reflection, and transmission spectra of 22 different NaI crystal samples, grown in crucibles of Pt or quartz under atmospheres of N_2 or H_2 or H_2 plus I_2 and in some cases containing stoichiometric excess of Na or I_2 or containing various concentrations of Tl, were explored from 2.5 to 8 eV. At −190°C an emission band centred at 295 mμ (4.20 eV) was observed in all but the one sample which contained the highest Tl concentration, 0.1 mole %. Another emission band at 375 mμ (3.31 eV) was found to be strongest in crystals containing excess I_2. A 425 mμ (2.92 eV) emission appeared strongly in all crystals containing Tl, but a 325 mμ (3.82 eV) band appeared only in the one crystal with 0.1 mole % Tl. With excitation energy below 5.5 eV the different emission bands arise from discrete excitation bands. With excitation energies above 5.5 eV up to 8 eV the emission was primarily in the 295 mμ band until Tl concentration reached 0.05 mole % where the 425 mμ band and 295 mμ band became approximately equal. Maxima in reflection spectra coincide closely but not exactly with published maxima in the absorption spectra of NaI evaporated films. An inflation, not seen in the published absorption spectra, appears at 5.62 eV in the reflection spectrum at −190°C. Coincidental with the lowest energy maximum in the reflection spectrum at 5.59 eV the excitation spectra for both 295 mμ and 425 mμ emission exhibit minima too strong to be accounted for by reflection loss. At excitation energies of 5.7 eV and above, luminescence quantum efficiency is greatest for an illuminating angle of incidence of 45° whereas at lower energies no definitely preferable incidence angle was found. Also with higher exciting energies it was found that the emission was strongest on the axis of illumination. With exciting energies below 5.5 eV the emission was isotropic.

539.2 : 535.37

21007 COHERENCE, NARROWING, DIRECTIONALITY, AND RELAXATION OSCILLATIONS IN THE LIGHT EMISSION FROM RUBY.

R.J.Collins, D.F.Nelson, A.L.Schawlow, W.Bond, C.G.B.Garrett and W.Kaiser.

Phys. Rev. Letters, Vol. 5, No. 7, 303-5 (Oct. 1, 1960).

A 5 mm diameter rod, 4 cm long, of Al_2O_3 containing 0.05%

Cr_2O_3, is silvered on the flat polished ends so as to transmit a few per cent of the fluorescence excited internally by a flash tube surrounding the rod. For high levels of excitation the ratio of the red lines emitted, R_1/R_2, increases from ~ 1 to ~ 10^3, the excess R_1 signal appearing between 0.5 and 1 msec as a series of short intense spikes on the oscilloscope trace. The light leaves the silvered ends at a small angle of divergence, of the same order as the variation of direction of the c-axis of the crystal along the length of the rod. Interference fringes obtained by an etalon show the line-width to be 0.2 cm^{-1} compared with the normal value of 6 cm^{-1}, while Fraunhofer diffraction patterns from a small aperture in a heavily silvered end show that coherence occurs over a distance of 100 wavelengths. Similar effects are found at liquid N_2 temperature.
S.T.Henderson

539.2 : 535.37

21008 LUMINESCENCE PROPERTIES OF ZINC OXIDE ACTIVATED WITH SELENIUM.

L.Ya.Markovskii and N.S.Orshanskaya.

Optika i Spektrosk., Vol. 9, No. 1, 77-82 (July, 1960). In Russian.

Reports an investigation of photoluminescence (excitation with 365 mμ light) and cathodoluminescence ($V = 9$ kV, $I = 1\ \mu A/cm^2$). Introduction of selenium produced a characteristic cathodoluminescence band at 610 mμ. This band was strongest in ZnO containing 0.2% Se, which exhibited also a band due to excess zinc (~505 mμ). The duration of afterglow of the selenium band was about ten times greater than that of the excess-zinc band. ZnO phosphors containing 0.3-0.4% Se did not have an excess-zinc band and their catholouminescence intensity amounted to 30% of the similar intensity of ZnO:Zn. Further increase of the amount of Se in ZnO produced concentration quenching of the selenium band. ZnO:Se phosphors were very sensitive to Cu, Fe and Ni impurities: Cu increased the duration of afterglow, while Fe and Ni reduced this duration considerably.
A.Tybulewicz

539.2 : 535.37

21009 DECAY PROPERTIES OF ZnS(Ag) PHOSPHORS.

T.Asada, M.Masuda, M.Okumura and J.Okuma.

J. Phys. Soc. Japan, Vol. 14, No. 12, 1766-70 (Dec., 1959).

The fact that a phosphor exhibits different decay times for different kinds of exciting radiation has recently been reported. This is expected to be found also in ZnS:Ag phosphors which are often applied in photonuclear experiments. Detailed measurements of such decay properties were carried out in the present work. The phosphor has two types of decay mode for a particular kind of radiation, one being exponential and another hyperbolic with time; the phosphor also has different decay constants in the exponential form decay for different kinds of radiation. The decay constants were 100 mμsec and 10 mμsec for α-particle and γ-ray excitation, respectively. This difference is contrary to previous work by Koontz et al. (Abstr. 5425 of 1955). Furthermore, it was observed that in the case of γ-ray excitation the decay is mainly exponential and in the case of α-particle excitation mainly hyperbolic. The difference of decay modes and the difference of the decay constants make it possible to discriminate protons or α-particles from a strong γ-ray background.

539.2 : 535.37

21010 THE RATIO OF INTENSITIES OF THE LUMINESCENCE BANDS OF ZnS:Mn AND ZnS:Ag:Mn PHOSPHORS AS A FUNCTION OF THE INTENSITY OF ELECTRON OR OPTICAL EXCITATION.

Yu.V.Voronov.

Optika i Spektrosk., Vol. 9, No. 1, 108-11 (July, 1960). In Russian.

Reports a parallel investigation of the effects of the electron density (10^{-9}-10^{-5} A/cm^2) and the mercury light intensity on luminescence of ZnS:Mn and ZnS:Ag:Mn phosphors with 10^{-3}-10^{-2} g/g Mn. A marked dependence of the colour of luminescence on the electron beam density was observed in a narrow range of activator concentrations: 3×10^{-3} g/g Mn in ZnS:Mn, and 10^{-4} g/g Ag and 1.5×10^{-3} g/g Mn in ZnS:Ag:Mn. At other activator concentrations one colour predominated at all the electron beam densities. Increases of the electron acceleration voltage (up to 35 kV) produced a rise of the activator band intensities without altering the ratio of the yellow (E_y) and blue (E_b) band intensities: $K = E_y/E_b$. For electrons and light the ratio K depended in the same way on the excitation intensity: $K = AI^{-b}$, where I is the intensity of the exciting light or the electron beam density, A and b are constants (for light $b = 0.72$, for electrons $b = 0.54$).
A.Tybulewicz

539.2 : 5357

21011 MIGRATION OF ENERGY OF THE ELECTRONIC EXCITATION BY A VIRTUAL-EXCITON MECHANIS

V.M.Agranovich.

Optika i Spektrosk., Vol. 9, No. 1, 113-15 (July, 1960). In Russia

Migration of the electronic excitation energy between impuri molecules is important in studies of plastic scintillators, e.g. po styrene containing a luminescent impurity. The present note sho that, apart from direct interactions between impurity molecules (for example dipole–dipole interactions), energy transfer can occur via virtual excitons. This mechanism of energy transfer i shown to be important at sufficiently low impurity concentrations. The role of the virtual-exciton mechanism becomes greater with increase of permittivity of the plastic medium.
A.Tybulew

539.2 : 535.

21012 LONG PERIOD AFTERGLOW OF KCl:Tl PHOSPHOR UNDER CATHODE-RAY EXCITATION.

V.V.Ratnam

Proc. Nat. Inst. Sci. India A, Vol. 25, No. 2, 111-17 (March, 195

The decay of the afterglow intensity of KCl:Tl phosphor excit by 11 kV cathode rays was studied over the temperature range 150° - 400° K. The decay constant was strongly influenced by the glow peaks exhibited by the phosphor, and it passes through maximum values near the temperature corresponding to the glow peaks. From the temperature variation of these decay constants the trap depth was estimated. The results show that the value of the frequency factor, is not the same for all the trapping centres.

539.2 : 535.37 : 621.383.2.032

21013 THEORIES OF ELECTROLUMINESCENCE.

D.Curie.

Progress in semiconductors, Vol. 2 (London: Heywood. 1957) p. 249-77.

The theories of three types of electroluminescence of solid crystals are reviewed. These are (a) "pure" or "intrinsic" electr luminescence (Destriau effect), (b) "carrier injection" electrolum escence, and (c) electrophotoluminescence (Gudden–Pohl effect) and other effects. The discussion of (a) includes the mechanism, the excitation process, the kinetics, the supply of electrons to the conduction band, the acceleration process, and conditions for good sensitivity. A brief account is given of electroluminescence organic substances. The discussion of (b) includes low field phen ena and field emission luminescence phenomena. The discussion (c) includes the Gudden–Pohl effect and the quenching and enhanc ing effects of electric fields on photoluminescence. 82 references
J.B.Bir

539.2 : 535.

21014 AVALANCHE ELECTROLUMINESCENCE IN CdS SINGLE CRYSTAL.

M.Kikuchi and S.Iizima.

J. Phys. Soc. Japan, Vol. 14, No. 6, 852 (June, 1959).

A rectifying cell is made from a CdS crystal with one In electrode and the other of Ag paste. Under pulsed d.c., breakdo occurs at about 25 V, with emission of light in almost linear relation to the current. The V–I characteristic is given.
S.T.Henders

539.2 : 535

21015 ELECTROLUMINESCENCE OF ZnS PHOSPHORS EXCITED BY SHORT FIELD PULSES.

S.Tanaka.

J. Phys. Soc. Japan, Vol. 14, No. 9, 1123-40 (Sept., 1959).

Electroluminescence in ZnS:Cu, Pb phosphors was investigat Excitation and recombination mechanisms of luminescent centres are discussed. Rectangular pulses were used having durations of from 1 to 40 μsec. From the experimental results of emission spectra, brightness waveforms, dependences of light outputs on th applied voltages and pulse durations, decay times, build-up chara teristics and their temperature dependences, it is concluded that the local intense field generated at the cathode region of phosphor particles accelerates the primary electrons and the luminescent centres are impact-ionized by these electrons. The field strengt may be smaller than in the case of sinusoidal field excitation and then the excitation efficiency of the primary electron greatly decreases compared with the latter case. The primary electrons a partly generated thermally and partly by the direct field-ionizatio The electroluminescence decay obeys the bimolecular law and is affected by the electron traps in the region of long pulse duration The build-up characteristics are also affected by the deep-lying electron traps.

539.2 : 535.37

1016 THE LIGHT WAVEFORMS EMITTED FROM ELECTROLUMINESCENT CELLS ENERGIZED BY SQUARE VES AND PULSES OF VOLTAGE. G.R.Hoffman and D.H.Smith.
lectronics and Control, Vol. 9, No. 3, 161-216 (Sept., 1960).

Light pulses which rise to a maximum in less than 0.2 μs can btained from electroluminescent cells excited by voltage wavens with fast edges. The pulses decay more slowly, taking from 3 μs at a p.r.f. of 50 kc/s and about 100 μs at 200 c/s, to decay ne-third of the maximum amplitude. The dependence of this ximum amplitude on the peak value of the voltage obeys a similar to that already found for the average brightness of a cell. These other features of the light pulses depend on the time-variation of electric field strength within the phosphor crystal. The wavem of the electric field is quite different from the applied voltage can be regarded as having two components due respectively to applied voltage and the internal space charge which is built up ing the first few cycles of excitation. The former can be found roximately from a simplified equivalent circuit, and information ut the latter can be obtained form a consideration of the part yed by electron traps in the mechanism of electroluminescence.

539.2 : 535.37

21017 TIME-DEPENDENT SPECTRA OF ELECTROLUMINESCENT ZnS:Cu,Pb.
Veiszburg, J.Schanda and Z.Bodó.
il. Mag. (Eighth Ser.), Vol. 4, 830-2 (July, 1959).

The spectra were recorded in such a way that distances along spectrograph slit corresponded to time variations. By crophotometry of the images, curves were derived showing ightness versus time for each of several emission wavelengths. ere is a negligible phase shift between green and blue bands for 0 c/s excitation, while at 740 c/s the green emission is retarded not more than 3% of the length of the cycle. S.T.Henderson

539.2 : 535.37

21018 RADIOTHERMOLUMINESCENCE OF ORGANIC COMPOUNDS. V.G.Nikol'skii and N.Ya.Buben.
kl. Akad. Nauk SSSR, Vol. 134, No. 1, 134-6 (Sept. 1, 1960). Russian.

The radiothermoluminescence curve was determined for polyhylene (both high and low-pressure), paraffin wax (also wax asticized with 1% CCl_4), n-$C_{18}H_{38}$, n-C_9H_{20}, polydimethylsiloxane, lyisobutylene, teflon, native rubber, rubbers SKI and SKB, and clohexane. A certain analogy between the maxima on these curves d on those of mechanical and dielectric losses was found for polyhylene. Other findings point to the thermoluminescence flares ing related to the "unfreezing" of the inhibited molecular motion polyethylene. Comparison of the results obtained (temperatures which maxima occur on the luminescence versus temperature rves) with the temperatures of structural transitions and with ermomechanical curves reveals a close coincidence of these temeratures. F.Lachman

MAGNETIC PROPERTIES OF SOLIDS

539.2 : 538.2

21019 HELICAL SPIN ARRANGEMENT IN CHROMIUM METAL. B.R.Cooper.
hys. Rev., Vol. 118, No. 1, 135-6 (April 1, 1960).

The lowest energy spin arrangements in a body-centered cubic ystal with first, second, and third nearest neighbour exchange teractions are given. The results may explain the experimental eutron diffraction pattern for chromium single-crystals as observed Corliss, Hastings, and Weiss (Abstr. 1816 of 1960). The susceptility of the helical array is calculated.

539.2 : 538.2

21020 DE HAAS–VAN ALPHEN EFFECT IN GRAPHITE BETWEEN 3 AND 85 KILOGAUSS.
.J.Spry and P.M.Scherer.
hys. Rev., Vol. 120, No. 3, 826-9 (Nov. 1, 1960).

The de Haas–van Alphen effect was measured in a single rystal of graphite between 3 and 85 kG with the c-axis of the crytal parallel to the magnetic field. Two periods were observed: .05 × 10^{-5} gauss^{-1} for the electronic component and 1.53 × 10^{-5} auss^{-1} for the holes. No new and unexpected oscillations were bserved at magnetic fields as large as 100 kG.

539.2 : 538.2

21021 THE MAGNETIC BEHAVIOUR OF REGULAR AND INVERTED CRYSTALLINE ENERGY LEVELS.
J.H.Van Vleck.
Disc. Faraday Soc., No. 26, 96-102 (1958).

"Ions of the transition elements" Conference paper (see Abstr. 20727 of 1960). A crystalline potential of dominantly cubic symmetry accounts largely for paramagnetic anisotropy in salts of the iron group. The great variations in the degree of anisotropy from ion to ion are caused by a peculiar inversion effect in the Stark pattern. A consistent cubic potential can be used throughout the iron group, but evidence is presented that in alums, though not in ferrites, the non-cubic portion of the field depends greatly on the nature of the cation itself because of the latter's "back action" on its surroundings. One such polarization mechanism is the Jahn-Teller effect. An explanation is given why this effect plays a fundamental rule in the Abragam–Pryce theory of the susceptibility of copper fluosilicate, and still is inconsequential in Low's microwave experiments on FeO and other oxides.

539.2 : 538.2

21022 THE MAGNETIC PROPERTIES OF SOME d_ϵ^3, d_ϵ^4 AND d_ϵ^5 CONFIGURATIONS.
B.N.Figgis, J.Lewis, R.S.Nyholm and R.D.Peacock.
Disc. Faraday Soc., No. 26, 103-9 (1958).

"Ions of the transition element" Conference paper (see Abstr. 20727 of 1960). The variation in the magnetic susceptibility over a temperature range for some complexes of osmium, ruthenium, rhenium and iridium, in d_ϵ^3, d_ϵ^4 and d_ϵ^5 configuration, were measured. This variation in susceptibility is discussed in terms of the Kotani theory and the relative importance of the various assumptions made in this theory are examined in the light of the magnetic data.

539.2 : 538.2

21023 THEORY OF THE MAGNETIC SUSCEPTIBILITY OF A POLARON. Dzh.I.Abakarov and Yu.M.Seiidov.
Fiz. tverdogo Tela, Vol. 2, No. 9, 2264-7 (Sept., 1960). In Russian.

By the spur operator method, and assuming loose coupling, the magnetic susceptibility of a polaron is calculated and investigated. N.Davy

539.2 : 538.2

21024 MAGNETIC SUSCEPTIBILITY OF Ce–Th ALLOY. T.Murao.
Progr. theor. Phys., Vol. 22, No. 2, 307-9 (Aug., 1959).

539.2 : 538.2

21025 MAGNETIC ANISOTROPY OF THE Fe^{++} ION IN SIDERITE. A.Mookherji and S.C.Mathur.
Indian J. Phys., Vol. 33, No. 9, 410 (Sept., 1959).

The relative anisotropy of the ionic susceptibility was measured for a natural trigonal crystal (containing 66% ferrous carbonate) and found to be 47%, which is, as expected, greater than the value, 41%, for the Cu^{++} ion in crystals with axial symmetry. E.P.Wohlfarth

539.2 : 538.2

21026 TEMPERATURE DEPENDENCE OF THE MAGNETIC SUSCEPTIBILITY OF INDIUM, LEAD AND TIN CRYSTALS. B.N.Aleksandrov, B.I.Verkin and I.V.Svechkarev.
Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 37-43 (July, 1960). In Russian.

A new version of the Faraday method is proposed for measurement of the magnetic susceptibility of In, Pb and Sn crystals in the temperature interval from room temperature to 20.4°K. The curves $\chi(T)$ obtained are characteristic of the whole group of elements which exhibit a long period de Haas–van Alphen effect. This signifies the existence of small electron groups.

539.2 : 538.2

21027 THE MAGNETIC INVESTIGATION OF Mn^{++}, Co^{++}, Ni^{++}, Cu^{++} AMMINE AND ANHYDRATE SALTS.
K.Kido and T.Watanabe.
J Phys. Soc. Japan, Vol. 14, No. 9, 1217-24 (Sept., 1959).

An investigation is presented of how the magnetic interaction and the crystalline field depend on the number of coordinations in complex salts. It is found, from measurements, that the magnetic susceptibilities of $Mn(NH_3)_6Cl_2$, $Mn(NH_3)_2Cl_2$, $Mn(NH_3)Cl_2$, $MnCl_2$, $Co(NH_3)_6Cl_2$, $Co(NH_3)_2Cl_2$, $Co(NH_3)Cl_2$, $CoCl_2$; $Ni(NH_3)_6Cl_2$, $Ni(NH_3)_2Cl_2$, $Ni(NH_3)Cl_2$, $NiCl_2$; $Cu(NH_3)_4SO_4.H_2O$, $Cu(NH_3)_2SO_4$, $CuSO_4$ follow closely the Curie–Weiss law in the temperature range from 90° to 600° K. Any appreciable deviation from the Curie–Weiss law was not observed, and it seems that the Curie constant C and the Weiss temperature θ in the equation $\chi_m = C/T + \theta$ generally increase as the coordination number decreases.

539.2 : 538.2

21028 PARAMAGNETIC SUSCEPTIBILITY OF SINGLE CRYSTALS OF SOME NICKEL SALTS.

T.Haseda, H.Kobayashi and M.Date.
J. Phys. Soc. Japan, Vol. 14, No. 12, 1724-7 (Dec., 1959).

The paramagnetic susceptibility of single crystals of NiK Tutton salt and $NiCl_2.6H_2O$ were measured in the temperature range 1.40-20.4° K. The anisotropic susceptibilities found in NiK Tutton salt are in very good agreement with the calculated values using the splitting parameters determined by paramagnetic resonance. In $NiCl_2.6H_2O$, the antiferromagnetic transition was found at about 6° K. The easy axis is along the axis perpendicular to the crystalline c-axis in the ac-plane.

539.2 : 538.2

21029 THE MAGNETIC SUSCEPTIBILITY OF VANADIUM BETWEEN 20 AND 293°K.

B.G.Childs, W.E.Gardner and J.Penfold.
Phil. Mag. (Eighth Ser.), Vol. 4, 1123-30 (Oct., 1959).

The magnetic susceptibility of four samples of pure vanadium metal, prepared by different methods, was measured at 20.77 and 293° K. The most reliable values obtained are 5.89, 5.88 and 5.81×10^{-6} e.m.u./g respectively. There appears to be no systematic dependence of susceptibility on the method of preparation but the values obtained are appreciably larger than those reported by previous workers. The reason for this difference is discussed in terms of the impurity contents of the vanadium used in the earlier work.

539.2 : 538.2

21030 METAMAGNETISM OF METHYLAMINE CHROME ALUM. K.Motizuki.

J. Phys. Soc. Japan, Vol. 14, No. 6, 759-71 (June, 1959).

Methylamine chrome alum shows antiferromagnetic ordering below 0.015°-0.02° K and it is known that this ordering results from the magnetic dipole–dipole interaction among the chromic ions. The present paper investigates, on the basis of the molecular field approximation, the phenomenon of transition below the Néel point from the antiferromagnetic state to the paramagnetic state caused by an applied field, at constant temperature or at constant entropy. Depending on the direction of the applied field relative to the crystalline axes and also on the shape of sample, different behaviours of the transition are obtained. For a spherical sample, three are studied, namely, the cases of H//[111], H//[100] and H//[10$\bar{1}$], and for an infinitely long sample two cases, i.e. the axis of the sample and H are both parallel to either [111] or [100]. An appendix gives a summary of a previous theoretical study by Kanamori, Motizuki and Yosida (1953) of the same kind of antiferro–paramagnetic transition in a two-sublattice antiferromagnet, in relation to the present investigation.

539.2 : 538.2

21031 THE PHENOMENOLOGICAL THEORY OF THE VOIGT EFFECT IN PARAMAGNETICS. L.M.Tsirul'nikova.

Zh. eksper. teor. Fiz., Vol. 36, No. 5, 1428-34 (May, 1959). In Russian. English translation in: Soviet Physics–JETP (New York), Vol. 36(9), No. 5, 1015-19 (Nov., 1959).

Gives a macroscopic calculation of the Voigt effect for microwaves in paramagnetic media. The medium was assumed electrically isotropic with a magnetic anisotropy caused by the static external field. Reasonable agreement with experimental results for $MnSO_4.H_2O$ was obtained. D.Walsh

539.2 : 538.2

21032 ON THE THEORY OF THE NON-RESONANCE ABSORPTION OF AN ALTERNATING MAGNETIC FIELD BY A FERROMAGNETIC DIELECTRIC.

M.I.Kaganov and V.M.Tsukernik.
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 518 (Aug., 1960). In Russian.

States that the results contained in a previous paper (Abstr. 10170 of 1960) are erroneous. Quotes a formula for the absorption coefficient in the case of a transverse magnetic field of frequency much greater than that of a spin wave with zero quasi-impulse. N.Davy

539:2 : 53

21033 ON THE INSTABILITY OF UNIFORM PRECESSION MAGNETIZATION.

L.N.Bulaevskii, V.M.Fain and G.I.Freidman.
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 516-17 (Aug., 1960). I Russian.

The establishment of non-uniform magnetization in magneti systems, placed in a constant external magnetic field, leads to t destruction of the uniform precessions. These become unstable small fluctuations cause waves of magnetization (spin waves) to grow. Here the conditions of stability and instability of uniform precessions in ferromagnetics and ferrimagnetics are deduced from formulae for the frequency of the spin waves in those substances, which are quoted without proof. A connection between t above and work by Suhl (1957) is pointed out. See also Abstr. 886 of 1958. N.I

539.2 : 5

21034 THE EXCITATION OF THE SPIN SYSTEM OF A FERROMAGNETIC BY A SPATIALLY NON-UNIFOR ELECTROMAGNETIC FIELD. E.I.Yakovlev.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 5, 1067-9 (Aug. 11, 1960). In Russian.

Using Heisenberg's model, the mean rate of change of the en of the spin system in a ferromagnetic, when a non-uniform electr magnetic wave is incident upon it, is calculated. Also the ratio o the absorbed to the incident energy is determined. This situation arises in magneto-optics. The special cases of rapid increase in absorption, classical resonance and resonance in the infrared reg are briefly discussed. The anomalous increase in absorption predicted has been found by other workers in nickel. N.D

539.2 : 53

21035 EXCITATION OF STANDING SPIN WAVES IN A FILM M.I.Kaganov.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 158-62 (July, 1960). In Russian.

The surface resistance (impedance) of a ferromagnetic metal film is calculated, taking into account the spatial dispersion of th magnetic susceptibility. The influence of the skin effect and boundary conditions for the magnetic moment on the standing spi wave excitation curve is examined.

539.2 : 53

21036 SOME MAGNETIC PROPERTIES OF THE ISING MODEL. D.M.Burley.

Phil. Mag. (Eighth Ser.), Vol. 5, 909-19 (Sept., 1960).

Two properties of the Ising model are considered. Firstly, b extrapolating appropriate series expansions, the spontaneous magnetization of a ferromagnet for three-dimensional lattices is obtained. From the results accurate values for the critical tempe ture are found. Secondly, the high temperature susceptibility of a antiferromagnet is derived from the approximation of Kikuchi. T resulting susceptibility curves show that for loose-packed lattices maximum value occurs at a temperature slightly above the critica point, while for the close-packed lattices no such effect is obtaine

539.2 : 538.2 : 530

APPLICATION OF SPHERICAL LATTICE GAS THEORY TO THE ISING MODEL OF FERROMAGNETISM. See Abstr. 18997

539.2 : 538

21037 MAGNETIC MOMENTS AND ELECTRON TRANSFER NICKEL-RICH BINARY ALLOYS.

J.Crangle and M.J.C.Martin.
Phil. Mag. (Eighth Ser.), Vol. 4, 1006-12 (Sept., 1959).

New measurements of the ferromagnetic saturation magnetization of nickel-rich binary alloys containing dissolved Al, Si, Sb or Ge are reported, and previous work on NiZn and NiSn alloys is re-assessed. It is shown that electrons are transferred from the solute atoms to the 3d band of nickel at rates lower than the maximum available valencies in every case.

539.2 : 53

21038 FERROMAGNETISM IN Pd-RICH PALLADIUM–IRON ALLOYS J.Crangle.

Phil. Mag. (Eighth Ser.), Vol. 5, 335-42 (April, 1960).

Ferromagnetism was detected in disordered solid solution alloys of Fe in Pd at compositions down to 1.25 atomic % of iron. Data are presented on magnetic moments and on Curie points. It

own that part of the observed magnetic moment must be
ciated with the Pd atoms, and cannot be completely localized
ron atoms.

539.2 : 538.2

21039 WEAK FERROMAGNETISM IN THE ANTIFERROMAGNETIC CRYSTAL $CoCO_3$.
.Borovik-Romanov and V.I.Ozhogin.
eksper. teor. Fiz., Vol. 39, No. 1(7), 27-36 (July, 1960).
ussian.

The magnetic properties of a $CoCO_3$ single crystal were studied
he weight method in the temperature range from 1.3° to 300°K.
greement with previous results (Abstr. 3435 of 1957) it is found
: below T_N = 18.1°K an antiferromagnetic ordering with weak
romagnetism appears in $CoCO_3$. Compared with the data for
CO_3 (Abstr. 11205 of 1959), $CoCO_3$ displays a very large aniso-
py of the magnetic susceptibility, a large magnitude of the spon-
eous ferromagnetic moment ($\sigma_0 \cong 1440$ c.g.s.m. per mole) and
harp peak of $\chi_\perp$ near T_N. It is shown that the latter can be
lained within the thermodynamic theory of weak ferromagnetism
l is related to the fact that when a magnetic field is imposed on a
stance in a non-ordered state it induces antiferromagnetic
iering in this substance. An anomaly is observed in the tempera-
e dependence of the spontaneous moment at low temperatures. It
ı be explained within the framework of the spin-wave theory as a
nsition from the excitation of a single branch to the excitation of
h branches of the spin-wave spectrum. As in the case of $MnCO_3$,
quantitative agreement with the predictions of the spin wave
ory is observed.

539.2 : 538.2

210340 ON THE MAGNETIC ANISOTROPY OF A PYRRHOTITE CRYSTAL. I.Mikami, T.Hirone, H.Watanabe, S.Maeda,
Adachi and M.Yamada.
Phys. Soc. Japan, Vol. 14, No. 11, 1568-72 (Nov., 1959).

Measurement of the magnetic anisotropy energy of a single
ystal of natural pyrrhotite in the c-plane was made by means of
torque method at room temperature with magnetic fields up to
000 Oe and at low temperature in a constant field. It was found
at the easy axis lay along $[2\bar{1}0]$ direction above −80°C which,
wever, changed to [100] direction below that temperature. The
rque curves in the c-plane were composed of two- and six-fold
mmetric parts. It was also found that in the range of strong
agnetic fields the six-fold symmetric part at room temperature
creased with the inverse square of the applied field; such a field
pendence is explained assuming a triad structure for the single
ystal of pyrrhotite. A remark is also given on the origin of
two-fold symmetric torque.

539.2 : 538.2

21041 STRESS-DEPENDENT MAGNETIZATION IN SOME QUARTZ-DOLERITES. D.W.Powell.
ture (London), Vol. 187, 225 (July 16, 1960).

539.2 : 538.2 : 550.3

21042 A DOMAIN THEORY OF MAGNETIC GRAINS IN ROCKS. F.D.Stacey.
il. Mag. (Eighth Ser.), Vol. 4, 594-605 (May, 1959).

The activation theory of domain wall movements cannot explain
e observed coercive forces of magnetic powders if the individual
ains are considered to be divided into lamellar domains with
ternately opposite directions of magnetization. Experimental data
e shown to be consistent with a "rod model" in which the grains
e divided into domains of square cross-section extending right
ross the grains. This model leads to a coercive force proportional
the $-\frac{3}{4}$ power of grain diameter, in agreement with observations
powdered magnetite. An approximate calculation of the energies
the two models indicates that the rod model has the lower energy
magnetostrictive strain is more important than magnetic aniso-
opy in determining domain structure. It appears probable that this
the case in magnetite, and therefore that the rod model gives a
etter picture of the domain structure of magnetic grains in rocks.

539.2 : 538.2

21043 MAGNETIC PROPERTIES OF THICK NICKEL LAYERS, DEPOSITED ELECTROLYTICALLY IN A MAGNETIC
IELD.
.Savin, S.Dumitrescu, N.Reus and V.Petrescu.
ull. Inst. Politeh. Iasi, Vol. 5 (IX), No. 3-4, 205-8 (1959). In
oumanian.

Thick nickel films, with fine grain and low internal stress, were achieved in a modified nickel sulphite bath; the deposits were easily removed by plating on a thin layer of tin. A number of samples were made with and without the presence of a magnetic field; in the former case, hysteresis loops are narrower, tending towards square-loop characteristics. It is assumed that this method of deposition results in crystal orientation along magnetic field lines. Equipment and the preparation of plating solutions are described. A.Reiss

539.2 : 538.2

21044 THE OBSERVATION OF DOMAIN STRUCTURE IN MAGNETIC THIN FILMS BY MEANS OF THE KERR MAGNETO-OPTIC EFFECT. M.Prutton.
Phil. Mag. (Eighth Ser.), Vol. 4, 1063-7 (Sept., 1959).

An apparatus is described in which the ferromagnetic domain structure in a polished surface is made clearly visible. Sufficient contrast is obtained by blooming the metal surface and by using a quarter-wave plate in the viewing telescope. Some results are described in which a film of 81 : 19 nickel iron containing a domain structure was subjected to a steady field at right angles to the anisotropy axis. These observations show that simple Bloch domain walls are not occurring and that the magnetization reversal process can proceed by simultaneous domain growth and rotation of the magnetization vectors within the domains.

539.2 : 538.2

21045 DOMAIN OBSERVATION IN THIN FERROMAGNETIC FILMS BY MEANS OF THE ELECTROMAGNETIC ELECTRON MICROSCOPE. E.Fuchs.
Naturwissenschaften, Vol. 47, No. 17, 392 (1960). In German.

A resolution about 0.1 μ was achieved after ensuring that the field of the electromagnetic lens system does not influence the film; by this means a fine domain structure could be observed on evaporated permalloy layers (see also Abstr. 6236 of 1960). E.P.Wohlfarth

539.2 : 538.2

21046 INFLUENCE OF THE SUBSTRATE TEMPERATURE ON THE MAGNETIC AND STRUCTURAL PROPERTIES OF EVAPORATED Ni THIN FILMS. A.Glodeanu and I.Teodorescu.
Rev. de Physique (Bucarest), Vol. 4, No. 4, 489-95 (1959).

For substrate temperatures T below 0°C the films have quite a high saturation magnetization, a well formed crystal structure and a square hysteresis loop. For $0°C < T < 140°C$ the specimens show a reduced saturation magnetization due to an imperfect crystal structure. For $T > 140°C$ the films again exhibit a large saturation magnetization. The coercivity seems to be independent of T and is about 250 Oe for thickness of 435 A. D.J.Oliver

539.2 : 538.2

21047 CHARACTERISTICS OF A LAYER OF FERROMAGNETIC PARTICLES IN SUSPENSION IN A MAGNETIC FIELD.
I.M.Kirko and M.V.Filippov.
Zh. tekh. Fiz., Vol. 30, No. 9, 1081-4 (Sept., 1960). In Russian.

The effect of the application of a vertical magnetic field to a thick layer of iron particles, suspended in a column of flowing water, is studied. The phenomenon called pseudo-liquefaction, and other features in the behaviour of the layer are described. Various stages in the series of changes are related to the Reynolds number of the water stream in a so-called "phase" diagram. N.Davy

539.2 : 538.2

21048 PLASTICALLY DEFORMED STEEL IN A WEAK MAGNETIC FIELD. A.W.Sleeswyk.
Acta metallurgica, Vol. 7, No. 10, 689-91 (Oct., 1959).

The magnetic induction of mild steel rods was measured after plastic deformation in both tension and compression. Both tensile and compressive plastic flow reduce the magnetic induction. The effect is much greater in tension and some of the reduction during tension is recovered by later compression. This is probably due to microcracks formed in tension being closed up again in compression. H.Mykura

539.2 : 538.2

21049 TEMPERATURE DEPENDENCE OF THE MAGNETOSTRICTION CONSTANTS IN IRON AND SILICON IRON.
E.Tatsumoto and T.Okamoto.
J. Phys. Soc. Japan, Vol. 14, No. 11, 1588-94 (Nov., 1959).

The magnetostriction constants λ_{100} and λ_{111} of Fe, 1.08 and

3.83% Si—Fe were measured by using single crystals at temperatures below the Curie point down to liquid air temperature with two newly designed apparatuses. In iron, λ_{100} has a minimum around 400° K, while λ_{111} monotonously decreases in numeral with increasing temperature. Addition of silicon to iron has a tendency to make the minimum in λ_{100} disappear and to decrease λ_{111} numerically at any temperature, retaining the similar monotonous variation with temperature. Several existing theories have been applied to account for the experimental results, but no theory appears to be successful in interpreting them.

539.2 : 538.2

21050 THE MAGNETIC CHARACTERISTICS OF A FERROMAGNETIC IN AN OSCILLATORY RÉGIME.

L.G.Ipatov.

Zh. tekh. Fiz., Vol. 30, No. 6, 685-9 (June, 1960). In Russian.

When a ferromagnetic is placed inside a solenoid fed with alternating current, there is a coupling or interaction between the electric current circuit and the mechanical oscillations to which the specimen is subjected. The dynamic magnetic characteristics differ from those obtained when the oscillations are damped or absent. The theory of this effect is discussed at some length. The effect manifests itself in the value of the magnetostrictive permeability, important in magnetostrictive apparatus. Experimental graphs and oscillograms obtained with the alloy permindur are shown, and their connection with the theory explained. N.Davy

539.2 : 538.2

21051 A NOTE ON THE MAGNETIC RELAXATION IN A LOW FIELD. M.Tanaka.

Progr. theor. Phys., Vol. 20, No. 2, 251-2 (Aug., 1958).

539.2 : 538.2

21052 THE ANHYSTERETIC REMANENCE OF MAGNETIC RECORDING TAPES. E.P.Wohlfarth.

Phil. Mag. (Eighth Ser.), Vol. 5, 717-22 (July, 1960).

The anhysteretic properties of magnetic tapes are discussed by introducing the idea of internal demagnetization spectra.

539.2 : 538.2

21053 THE SILVER-BASED HEUSLER ALLOYS.

E.O.Hall.

Phil. Mag. (Eighth Ser.), Vol. 4, 730-44 (June, 1959).

The structures of some fifty alloys of silver, manganese, and aluminium were studied with a view to explaining the magnetic properties of these alloys. Approximate equilibrium diagrams were made at 400° and 650°C, and the alloys were also examined after quenching from the latter temperature. It follows from this examination that ferromagnetism in alloys in the vicinity of the atomic composition Ag_5MnAl is not associated with any equilibrium product, but arises from a finely dispersed nucleation structure, which grows during ageing into a Widmanstätten pattern and eventually transforms above the Curie point into β-manganese, rendering the alloy non-ferromagnetic. The ferromagnetic precipitate was extracted and identified by electron diffraction as having an ordered hexagonal structure with $a = 2.94$ A, $c/a = 1.61$. This result is used to discuss the variation of magnetization with temperature in these alloys, and also the origin of their very high coercivities. A brief discussion of the valency of manganese in these structures is also included.

539.2 : 538.2

21054 FERROMAGNETIC CRYSTALLINE ANISOTROPY OF Fe–Mn-FERRITE SYSTEM.

Z.Funatogawa, N.Miyata and S.Usami.

J. Phys. Soc. Japan, Vol. 14, No. 11, 1583-7 (Nov., 1959).

Ferromagnetic resonance absorption of microwave (9300 Mc/s) in synthetic single crystals of $Mn_xFe_{3-x}O_4$ $(0.2 \leq x \leq 1.15)$ has been investigated to study their magnetic crystalline anisotropy, g-factor and line width. The pronounced valley in the curve, magnetic crystalline anisotropy $(-K_1/M)$ versus composition (x), was observed in the temperature region between 90° and 300° K. $(-K_1/M)$ was a minimum in the region $0.6 < x < 0.7$ and changed its sign. The g-value and line width decreased with x more rapidly in the region $x < 0.6$ than $x > 0.6$. It seems difficult to explain these experimental results on the view point of one-ion-model which proved successful in many other ferrites.

539.2 : 538.2

21055 THE EFFECT OF UNIAXIAL COMPRESSION ON MAGNETIZATION OF SOME FERRITES. Ya.M.Bekker.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1708-13 (Aug., 1960). In Russ

The effect of uniaxial pressures up to 4.8 kg/mm^2 on normal magnetization curves of NiMg ferrites was studied at 18°C. In a samples a Villari point (the point of intersection of the normal magnetization curves with and without load) was observed. The effect of pressure was determined at various ferrite compositio and magnetizing fields. A.Tybule

539.2 : 5

21056 HIGH-PERMEABILITY GARNETS.

E.E.Anderson and J.R.Cunningham, Jr.

J. appl. Phys., Vol. 31, No. 9, 1687-8 (Sept., 1960).

Initial results of the substitution of indium for part of the ir in yttrium iron garnet (YIG) are reported. The most striking res is the large increase in initial permeability — from ~100 to ~50 by the substitution of 10% of indium. It is also found that ferromagnetic relaxation sets in at a lower frequency ~1 Mc/s than th unsubstituted YIG. The samples were prepared by previously described (Abstr. 3093 of 1960) techniques, but it is found that higher sintering temperatures are required to obtain high density samples. The upper limit of indium substitution possible is not yet known, but a range of samples of appropriate concentration (u to 20% indium) are being prepared. S.A.Ah

539.2 : 53

21057 ON THE INCORPORATION OF NEODYMIUM IN MIXE YTTRIUM–NEODYMIUM–IRON GARNETS.

G.Goldring, M.Schieber and Z.Vager.

J. appl. Phys., Vol. 31, No. 11, 2057-9 (Nov., 1960).

The preparation and saturation magnetization of yttrium–iro garnets containing various amounts of neodymium was investigate The amount of Nd which can be incorporated in the garnet structu was determined crystallographically and magnetically. The chemical analysis of the Nd/Y ratio was carried out by the counting of the characteristic X-rays of Nd produced by proton bombardment in a Van de Graaff accelerator. A compound with a formula of $YNd_2Fe_5O_{12}$ was found to be the richest iron garnet containing Nd and has a saturation magnetization, at room temperature, of 4.25 ± 0.13 Bohr magnetons per formula weight compared to that o 3.55 ± 0.13 of $Y_3Fe_5O_{12}$ or $Sm_3Fe_5O_{12}$.

539.2 : 53

21058 ON THE THEORY OF SUPEREXCHANGE INTERACTI

S.Koide, K.P.Sinha and Y.Tanabe.

Progr. theor. Phys., Vol. 22, No. 5, 647-62 (Nov., 1959).

The superexchange interaction for the spin coupling in certain magnetic compounds is treated on the basis of an approach which takes into account the deformation of the electron orbitals of the intervening ions. Quantitative calculations are carried out for three-centre and four-electron systems. The polarization of the intervening ion is considered by assuming slightly different orbita for the two electrons with anti-parallel spins. This corresponds t the procedure of taking certain excited configurations into conside tion. The effect of the excited states in which one of the anion electrons changes its spin is also considered by using the perturb tion method. If one regards the triplet and singlet states of the system as the representatives of the ferromagnetic and antiferromagnetic states respectively, their energy difference arises as a result of the latter effect, while the same occurs by merely considering the former deformation if one uses the single determi approximation. A rough numerical estimate gives a reasonable agreement with the observed Néel temperature for MnO.

539.2 : 53

21059 SUPEREXCHANGE INTERACTION: THE FOUR ELECTRON MODEL. J.Kondo.

Progr. theor. Phys., Vol. 22, No. 6, 619-29 (Dec., 1959).

The superexchange interaction of the four-electron model is investigated, including various excited configurations. The only assumption used is that the overlap between atomic orbitals is small. It is shown that the superexchange interactions of the fou electron model can be represented by a spin Hamiltonian $2Js_As_C$ even when the non-orthogonality of wave-functions is taken into account, and even when various mechanisms of superexchange interaction are included simultaneously in the effective interacti J. It is also shown that a single-configuration approximation like that used previously (Abstr. 2387 of 1958) gives a result which is very close to the correct one in the four-electron model. It is argued, therefore, that as long as one looks for the difference in energy between the parallel and the ordered antiparallel states, t ential features are involved in single-configuration approxi- ion even when it is applied to real crystals, as in the paper d.

539.2 : 538.2

1060 SUBLATTICE MAGNETIZATION AND RESONANCE FREQUENCY OF ANTIFERROMAGNETS WITH LARGE XIAL ANISOTROPY.

B.R.Cooper.

. Rev., Vol. 120, No. 4, 1171-5 (Nov. 15, 1960).

The effect of large anisotropy on the thermal behaviour of the attice magnetization and antiferromagnetic resonance frequency scussed. It is shown that the curves for M(T)/M(0) and /ω(0) versus T/T_C are shifted upward from those predicted by illouin function magnetization curve. The shifts are due to a bination of the effect of the large anisotropy energy with that of tron exchange correlation. Corrections to the molecular field oximation arising from pair correlations are taken into account n extension of the Oguchi method. These corrections are ex- ed to be roughly 1/Z as large as the more accurate corrections h would arise from correlation with all Z neighbours. This ectation is supported by a comparison of the values of kT_C/J and for the Oguchi method with those obtained by the Bethe–Peierls– ss and spin-wave methods, respectively. The results are related ie experiments on FeF_2 where the anisotropy is comparable to exchange energy.

539.2 : 538.2

21061 THE EFFECT OF ADDED TITANIUM ON THE MAGNETIC BEHAVIOUR OF HAEMATITE.

.Finlayson and T.Smith.

l. Mag. (Eighth Ser.), Vol. 4, 1160-3 (Oct., 1959).

It is shown that the solution of about 1% titanium in α-haematite s not suppress the rapid change in either the susceptibility or parasitic ferromagnetism which are associated with the change he direction of the antiferromagnetic axis near 260° K. The sults also suggest that the variation with temperature of the room nperature remanent magnetization is not always a reliable indi- ion of whether an axial switch has taken place.

539.2 : 538.2

21062 ANTIFERROMAGNETIC PROPERTIES OF THE Ni_3Fe ALLOY IN RELATION TO ITS ORDERED STATE.

V.Dekhtyar.

z. Metallov i Metallovedenie, Vol. 9, No. 3, 345-52 (March, 1960). Russian.

The temperature dependence of the magnetic properties of dered Ni_3Fe was studied and compared with the anomalous tem- rature-dependence of the same properties of this alloy in the dis- dered state. It was found that, irrespective of the degree of order the alloy at the beginning of the experiment, the antiferromagnetic change interaction takes place in the Ni_3Fe above 510° C and below e paramagnetic transformation temperature. At temperatures 300° C, weak magnetic fields destroy the antiferromagnetic coup- ig in the disordered, but not in the ordered, alloy. Above 300° C, e degree of the short-range order in the disordered alloy increases ith rising temperature, and the antiferromagnetic exchange inter- tion takes place, as a result of which the magnitude of the magnetic oment in weak fields is considerably reduced. M.H.Sloboda

539.2 : 538.2

21063 NEUTRON AND OPTICAL STUDIES OF DOMAINS IN NiO.

W.L.Roth.

. appl. Phys., Vol. 31, No. 11, 2000-11 (Nov., 1960).

Antiferromagnetic domains in NiO have been studied by neutron iffraction and optical observation of single crystals. There are two inds of antiferromagnetic domain walls, T (twin) and S (spin- otation). A T wall is produced by rotation of the antiferromagnetic attern of magnetic moments and an S wall by rotation of the direc- on of the magnetic moments. The T walls can be observed with olarized light, and both T- and S-type domains can be studied by eutron diffraction. Crystals with simple T-wall structures are roduced by annealing at high temperature. The crystallography of ie T walls can be understood in terms of a small rhombohedral eformation which accompanies the antiferromagnetic ordering. he T walls are easily displaced by the application of small mech- nical stresses or magnetic fields. A crystal without T walls may till contain S walls, and these S walls also are displaced or rotated y magnetic fields.

539.2 : 538.2

21064 A NEW TYPE OF ANTIFERROMAGNETIC STRUCTURE IN THE RUTILE TYPE CRYSTAL.

A.Yoshimori.

J. Phys. Soc. Japan, Vol. 14, No. 6, 807-21 (June, 1959).

A new type of antiferromagnetic spin arrangement, which is theoretically possible in the rutile type crystal and seems to be realized in polianite, MnO_2, is proposed. This spin arrangement, which is named the screw-type structure, consists of spins screwing along the four-fold crystalline axis. The stability ranges of this and other spin structures are studied, assuming three different exchange interactions. The magnetic properties of the screw-type structure, including the anisotropy energy due to dipolar interaction and that due to crystalline field, the susceptibility, the spin waves, and the neutron diffraction pattern, are studied. Neutron diffraction data for polianite obtained by Erickson (unpublished) can well be accounted for by the screw-type structure with a pitch of (7/2)c. The magnetic properties of the MnO_2 crystal are discussed on the basis of the 7/2-pitch-structure.

539.2 : 538.2 : 548.7

DEFECTS IN THE CRYSTAL AND MAGNETIC STRUCTURES OF FERROUS OXIDE. See Abstr. 20790

Magnetic Resonances

539.2 : 538.27

21065 NONLINEAR EFFECTS OF CRYSTALLINE ANISOTROPY ON FERRIMAGNETIC RESONANCE.

P.Gottlieb.

J. appl. Phys., Vol. 31, No. 11, 2059-62 (Nov., 1960).

The crystalline anisotropy of a ferrimagnetic solid will cause the magnetic resonance frequency to depend upon the angle of precession. It is shown that the resonance frequency depends quadratically upon the precession amplitude to lowest order. It is also shown that the dependence of this quadratic term upon the magnetic field orientation with respect to the crystal axis is the same as dependence of the usual zero-order resonance term upon orientation of the magnetic field. It is shown that the quadratic nonlinear term can cause a foldover of the resonance line, even in a spherical sample which is usually considered to have no fold-over. The necessary conditions for the onset of this fold-over are discussed, and some experimental results are mentioned.

539.2 : 538.27

21066 SIZE EFFECTS ON THE FERRIMAGNETIC RESONANCE ABSORPTION OF POLYCRYSTALLINE FERRITES AND GARNETS.

H.Yonemitsu.

J. Phys. Soc. Japan, Vol. 14, No. 5, 688-9 (May, 1959).

Measurements have been made at X-band of the size effect, defined as the variation of resonance line width ΔH with sample diameter, D, in samples of nickel ferrite, nickel–copper ferrite, nickel–copper–zinc ferrite, nickel–cobalt ferrite and yttrium–iron garnet. It is shown that the behaviour can be represented by an empirical equation of the form $\Delta H = a + \alpha D^2$ where α is a proportionality constant, which is strongly dependent on the porosity. S.A.Ahern

539.2 : 538.27

21067 EXPERIMENTS ON CHARGE TRANSFER AND EXCHANGE INTERACTIONS.

J.Owen.

Disc. Faraday Soc., No. 26, 53-7 (1958).

"Ions of the transition elements" Conference paper (see Abstr. 20727 of 1960). A brief review is given of recent experiments concerning exchange interactions between paramagnetic transition group ions in crystals by the mechanism of electron transfer to intervening diamagnetic ions (superexchange). The approximate amount of electron transfer can be measured in favourable cases by both electron and nuclear magnetic resonance techniques. The exchange interaction can also be measured by electron magnetic resonance. Some examples are discussed, particularly chloroiridate salts.

539.2 : 538.27

21068 SPIN–SPIN INTERACTION IN THE PARAMAGNETIC SALTS.

K.Sugihara.

J Phys. Soc. Japan, Vol. 14, No. 9, 1231-4 (Sept., 1959).

The spin–spin interaction via phonon exchange is proposed as the mechanism of the exchange interaction between the electron spins of the paramagnetic ions in crystal. The interaction Hamiltonian derived by Van Vleck (1939) to account for the spin–lattice relaxation phenomenon is used to make a numerical estimate. It is shown that the interaction through phonon exchange may have the same order of magnitude as the dipolar coupling in some of the paramagnetic salts. This interaction is temperature independent and at large distances falls off as the inverse cube of the interatomic distance. In nickel Tutton salts, the magnitude of the interaction is about 10^{-3} cm^{-1} at 12 A, which is comparable with that of the dipolar interaction.

539.2 : 538.27

21069 ELECTRON RESONANCE STUDIES OF TRANSITION METAL OXYIONS. I. EXPERIMENTAL RESULTS FOR THE MANGANATE, HYPOMANGANATE AND FERRATE IONS.

A.Carrington, D.J.E.Ingram, K.A.K.Lott, D.S.Schonland and M.C.R.Symons.

Proc. Roy. Soc. A, Vol. 254, 101-10 (Jan. 19, 1960).

Detailed electron spin studies of single crystals of potassium chromate containing manganate and ferrate ions and of potassium orthovanadate containing hypomanganate ions are described and the appropriate spin Hamiltonians are determined. The results confirm the tetrahedral structure of these ions and the assignation of spin S = 1 to ferrate and hypomanganate. A discussion of the qualitative nature of the results shows that the unpaired electrons in these ions occupy a doubly degenerate molecular orbital.

539.2 : 538.27

21070 ELECTRON RESONANCE STUDIES OF TRANSITION METAL OXYIONS. II. THEORY OF ELECTRON RESONANCE IN MANGANATE.

D.S.Schonland.

Proc. Roy. Soc. A, Vol. 254, 111-18 (Jan. 19, 1960).

It is shown that the detailed electron spin resonance spectrum of the manganate ion, $(MnO_4)^{2-}$, can be explained by assuming that the unpaired electron is in a doubly degenerate molecular orbital of symmetry type E and that the first excited state available to it is triply degenerate of symmetry type T_2. The results indicate that the E orbital is largely concentrated on the manganese atom while the T_2 orbital is spread over the whole molecule. As a result of this analysis the quadrupole moment of Mn^{55} is estimated to be 0.2 × 10^{-24} cm^2.

539.2 : 538.27

21071 ELECTRON PARAMAGNETIC RESONANCE OF EUROPIUM (II) IN SINGLE CRYSTALS OF CADMIUM SULFIDE.

P.B.Dorain.

Phys. Rev., Vol. 120, No. 4, 1190-2 (Nov. 15, 1960).

Paramagnetic resonance absorption measurements were made with single crystals of cadmium sulphide containing europium (II). The results can be fitted to the usual spin-Hamiltonian for ^8S state. The zero field splitting is about 0.4 cm^{-1}. The results are compared with present theories of the crystal field splittings of ^8S.

539.2 : 538.27

21072 PARAMAGNETIC RESONANCE IN THE QUASI SINGLE CRYSTAL $CrCl_3$.

G.A.Egorov and Yu.V.Yablokov.

Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 265-6 (Aug., 1960). In Russian.

Measured at room temperature at 36 kMc/s. An anisotropy of the g factor ($g_\perp = 1.989 \pm 0.001$; $g_\parallel = 1.984 \pm 0.001$) was detected which is accompanied by a change in the width of the absorption line: $\Delta H_\perp = (98 \pm 2)$Oe; $\Delta H_\parallel = (140 \pm 5)$Oe.

539.2 : 538.27

21073 PARAMAGNETIC RESONANCE FINE STRUCTURE SPECTRUM OF A CHROMIUM ION IN CHROME ALUM, INCORPORATING THE CALCULATION OF HIGH-ORDER TERMS.

A.M.Vasil'ev.

Fiz. tverdogo Tela, Vol. 2, No. 9, 2252-63 (Sept., 1960). In Russian.

The initial splitting of the ground state of a chromium ion in chrome alum, determining the fine structure of the paramagnetic resonance spectrum, is calculated, incorporating terms of higher order. These relate to two configurations of the external d^3 and d^2s electrons. The wave-function of a free chromium ion in an alum crystal is determined. The effects of fields of cubic and trigonal symmetry, and the case of spin—orbital coupling are discussed in detail. It appears that only the term $^4F'$ of the d^2s configuration affects the initial splitting, reducing it somewhat. The quantitative correction for this is calculated. N.Davy

539.2 : 538

21074 ELECTRON PARAMAGNETIC RESONANCE AND SPI LATTICE RELAXATION OF THE Co^{2+} ION IN CORUNDUM.

G.M.Zverev and A.M.Prokhorov.

Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 57-63 (July, 1960). In Russian.

The constants of the spin Hamiltonian of two unequivalent ion systems were measured, together with dependence of the spin—lattice relaxation time on temperature. It is shown that at helium temperatures the Co^{2+} ion has anomalously large relaxation time Effects are observed which are related to crossed spin—spin relaxation between the hyperfine structure components.

539.2 : 538.

21075 ELECTRON TRANSFERS AMONG TRANSITION ELEMENTS IN MAGNESIUM OXIDE.

J.E.Wertz, P.Auzins, J.H.E.Griffiths and J.W.Orton.

Disc. Faraday Soc., No. 26, 66-71 (1958).

"Ions of the transition elements" Conference paper (see Abstr 20727 of 1960). All single crystals of MgO available to the author contained iron-group impurities in quantities easily detectable by e.s.r. absorption. For a given impurity, the fractions in the di- and tri-valent states depend in part upon the past heat treatment and upon the concentrations of the other impurities. Energetic radiation may cause electron transfer to occur among the impurities. Oxygen of the crystal may partake in these transfers.

539.2 : 538.

21076 THE BONDING AND VALENCE PROPERTIES OF IRO GROUP IMPURITIES IN NaF.

W.Hayes.

Disc. Faraday Soc., No. 26, 58-65 (1958).

"Ions of the transition elements" Conference paper (see Abstr 20727 of 1960). The paramagnetic resonance spectra of iron group ions present as trace impurities in NaF were investigated and the ions Cr^+, Mn^{2+}, Fe^+, Co^{2+}, Co^+ and Ni^+ were observed. The monovalent ions were produced by irradiating a crystal containing the corresponding divalent impurity with γ-rays, X-rays o electrons and are stable to about 140° C. Each impurity ion forms a weak covalent complex with the surrounding octahedron of fluorine ions resulting in a fluorine hyperfine structure in the resonance spectrum. The bonds are of the σ-type and for Cr^+, Mn^{2+} and Fe^+ the amount of electron transfer is estimated.

539.2 : 538.

21077 PARAMAGNETIC RESONANCE IN POTASSIUM OZONIDE.

A.K.Piskunov, A.A.Manenkov and Z.A.Bagdasar'yan.

Zh. eksper. teor. Fiz., Vol. 37, No. 1(7), 302-4 (July, 1959). In Russian. English translation in: Soviet Physics—JETP (New York Vol. 37(10). No. 1, 213-14 (Jan., 1960).

Paramagnetic resonance was observed in polycrystalline samp at room temperature and 77° K, and at frequencies of 2580, 9375, 12 000 and 37 000 Mc/s. The dependence of line width upon tempera ture and frequency indicate that the g-value is anisotropic ($g_\parallel = 2.005 \pm 0.003$, $g_\perp = 2.012 \pm 0.002$) and that the line is exchan narrowed. This confirms that the magnetism of the molecular ion ozone, O_3^-, to which the paramagnetic resonance in KO_3 is due, has the character of a free radical. These results are similar to those found in NaO_3 by Bennett, Ingram and Schonland (Abstr. 8278 of 195 The kinetics of the spontaneous decomposition of KO_3 at 295° K was also studied. J.M.Bak

539.2 : 538.

21078 PARAMAGNETIC STUDIES OF RADIATION DAMAGE IN SILICA GEL.

H.W.Kohn.

J. chem. Phys., Vol. 33, No. 5, 1588 (Nov., 1960).

Several paramagnetic resonances and a new colour centre are reported in samples first heated to above 500° C in vacuum and the γ-irradiated at about 50° C. J.E.Caffy

539.2 : 538.

21079 PARAMAGNETIC RESONANCE IN MONOCRYSTALLI TIN.

M.S.Khaikin.

Zh. eksper. teor. Fiz., Vol. 39, No. 3(9), 899-901 (Sept., 1960). In Russian.

Reports the observation of the electron spin resonance of the conduction electrons in a large single crystal of very pure (impurities < 6 × 10^{-5} %) tin. The sample measured 11 × 6 × 1 m The measurements were made at 10^{10} c/s and at 2.3° K, the sampl ng part of a resonator wall. The signal is similar in width ıtensity to that from 10^{-10} mole of DPPH. The signal depends little on the orientation of the crystal in the field, moving less .ts width but varying somewhat in amplitude. The g value is 5 ± 0.0003. The T_2 value is discussed in its relation to electron free path and the relevance of sample size. J.G.Powles

539.2 : 538.27

080 PARAMAGNETIC RESONANCE IN PHOSPHORESCENT AROMATIC HYDROCARBONS. I. NAPHTHALENE.
ʼan der Waals and M.S.de Groot.
cular Phys., Vol. 2, No. 4, 333-40 (Oct., 1959).

Hutchison and Mangum (Abstr. 2219 of 1959) have observed ron spin resonance in the lowest triplet state of naphthalene. nalysis of their results is given on the basis of spin–spin action between the two unpaired electrons. In addition to the observed by these authors another transition, which corres- s to $\Delta m = \pm 2$ in the atomic case, must occur at low field ıgth. This transition was observed in a mixed crystal as as in rigid glass solution.

539.2 : 538.27

1081 DYNAMIC POLARIZATION OF Si^{29} AT LOW TEMPERATURE. J.Combrisson and I.Solomon.
hys. Radium, Vol. 20, No. 7, 683-90 (July, 1959). In French.

Describes apparatus and experimental results at liquid helium perature.

539.2 : 538.27

1082 NUCLEAR MAGNETIC RESONANCE IN β-BRASS. G.W.West.
. Mag. (Eighth Ser.), Vol. 5, 899-907 (Sept., 1960).

The nuclear magnetic resonance lines from β-brass at room perature were studied as a function of composition and deforma- . A simple model is proposed to explain the variation of nsity with composition. The Knight shift is 0.14%, independent omposition. Filing at room temperature eliminates the line n most specimens but it can be restored by annealing. Changes ne shape occur before, during, and after recrystallization.

539.2 : 538.27 : 539.3

21083 STRAIN-BROADENING OF NUCLEAR MAGNETIC RESONANCE LINES IN COPPER. E.A.Faulkner.
.l. Mag. (Eighth Ser.), Vol. 5, 843-51 (Aug., 1960).

The mean-square width of the nuclear magnetic resonance orption line in copper sheet was measured with an accuracy of %, using specimens from a sample of copper (99.98% Cu) on .ch stored energy measurements had already been made arebrough et al. 1957). Plastic deformation was found to increase mean-square line width by up to 40% and there is evidence that broadening is proportional to the stored energy. There is also mall reduction in the integrated intensity of the line in deformed ecimens, possibly caused by the high strains in regions near the es of dislocations. The results can be interpreted satisfactorily a model where both the line width and the stored energy are culated from the state of strain of the material.

539.2 : 538.27

21084 NUCLEAR MAGNETIC RESONANCE IN SILVER–CADMIUM. L.E.Drain.
ıil. Mag. (Eighth Ser.), Vol. 4, 484-501 (April, 1959).

Nuclear magnetic resonance shifts and line widths were easured in alloys of silver and cadmium at 300^0 K in a field of 00 G. The resonances of Ag^{109} and Ag^{107} nuclei were observed in e α and β phases and those of Cd^{113} and Cd^{111} nuclei in all the room mperature phases. In primary solutions of cadmium in silver, the ıight shifts of all the resonances decrease linearly as the cadmium ntent increases, the total variation being about 14% of their values the centre of the phase range. It is shown that in a disordered loy a contribution to nuclear magnetic resonance line width can ise from the variations of the shifts of nuclei with their immediate ırroundings. The results suggest that in α silver–cadmium loys, the influence of the cadmium atoms on the shift of silver ıclei is confined to nearest and next nearest neighbours. Line idths in the β phase suggest an ordered structure. The relation nuclear magnetic resonance shifts to the density of states at e Fermi surface is discussed and a calculation of the variation this quantity with composition made from the Knight shift results. ıe result is compared with other experimental and theoretical idence.

539.2 : 538.27

21085 NUCLEAR MAGNETIC RESONANCE IN LITHIUM AND DILUTE LITHIUM–MAGNESIUM ALLOYS. D.G.Hughes.
Phil. Mag. (Eighth Ser.), Vol. 5, 467-71 (May, 1960).

The Knight shift and line-width of the Li^7 resonance in dilute Li–Mg alloys was investigated. The observed rapid fall in Knight shift with alloying concentration is interpreted using Drain's theory. Linewidth measurements show that the activation energy of self-diffusion of the Li^7 atoms increases from 13.1 ± 0.2 kcal/mole for pure lithium to 14.5 ± 0.3 kcal/mole for the 10 at.% magnesium alloy.

539.2 : 538.27

21086 NUCLEAR MAGNETIC RESONANCE IN PLASTICALLY DEFORMED ROCK SALT.
M.I.Kornfel'd and V.V.Lemanov.
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 262-4 (Aug., 1960).
In Russian.

The intensity of the Na^{23} resonance line was measured as a function of the degree of deformation.

539.2 : 538.27

21087 NUCLEAR QUADRUPOLE RESONANCES OF NITROGEN IN AMINO AND AMIDO COMPOUNDS. M.Minematsu.
J. Phys. Soc. Japan, Vol. 14, No. 8, 1030-8 (Aug., 1959).

Pure quadrupole spectra of N^{14} in para-bromoaniline, para-chloroaniline, para-phenylenediamine, and urea were obtained. From the spectra, quadrupole coupling constants and asymmetry parameters were determined. The apparent intensity of the high-frequency line was always greater than that of the low-frequency line when Zeeman modulation was applied. This fact was interpreted from the second-order perturbation theory of the Zeeman effect. By using frequency modulation, the intensity difference between two lines became so small that it was interpreted as due to the population-difference between each state. The principal axis system of nitrogen in para-bromoaniline was determined. It is concluded that the three bonds about nitrogen are coplanar with the plane of the benzene ring.

539.2 : 538.27

21088 CHANGE OF INTENSITY OF NUCLEAR QUADRUPOLE RESONANCE IN A MOLECULAR CRYSTAL IRRADIATED WITH FAST ELECTRONS. A.I.Kitaigorodskii and É.I.Fedin.
Dokl. Akad. Nauk SSSR, Vol. 130, No. 5, 1005-7 (Feb. 11, 1960).
In Russian.

Polycrystalline specimens of n-dichlorobenzene were irradiated with 750 keV electrons and the nuclear quadrupole resonance was measured. The resonance amplitude decreased at first with increasing dose and then became approximately constant. This behaviour is discussed in relation to the structural changes produced in the material by the irradiation. R.F.S.Hearmon

539.2 : 538.27

21089 PROTON MAGNETIC RESONANCE IN HYDRATES OF HALOGEN COMPOUNDS OF Mg, Ca, Sr AND Ba.
S.Yano.
J. Phys. Soc. Japan, Vol. 14, No. 7, 942-54 (July, 1959).

Proton resonance in $Mg(H_2O)_6Cl_2$, $Mg(H_2O)_6Br_2$, CaI_26H_2O, SrI_26H_2O and MgI_28H_2O was studied in temperature range from -90^0 to $+110^0$ C and the same in $CaCl_26H_2O$, $CaBr_26H_2O$, $SrCl_26H_2O$ and $SrBr_26H_2O$ was studied in the range above room temperature, all in powdered states. Line shapes were recorded by a radiofrequency spectrometer with an automatic field scanning apparatus connected to the sweeping coils of a permanent magnet. Transitions of second moment and line shapes were observed for all the above salts. Experiments on single crystals of $Mg(H_2O)_6Cl_2$ and CaI_26H_2O were also carried out at room temperature. In $Mg(H_2O)_6Cl_2$, $Mg(H_2O)_6Br_2$, CaI_26H_2O, SrI_26H_2O and BaI_26H_2O, water molecules of hydration have states of hindered rotational motion below the melting point, but in $CaCl_26H_2O$, $CaBr_26H_2O$, $SrCl_26H_2O$ and $SrBr_26H_2O$, these rotational states were not observed. The angle between the rotational axis of a water molecule and its interproton direction was estimated to be about 90^0 in the case of $Mg(H_2O)_6Cl_2$. In the cases of CaI_26H_2O and SrI_26H_2O these angles are calculated to be 45^0 or 60^0, and these results suggest the precession of the rotational axis, if the rotational motion of water molecules is assumed to occur about an axis perpendicular to the interproton axis. Sharp peaks appearing in chlorides and bromides of Ca and Sr are interpreted as the narrowing due to random reorientation of the rotational axis.

539.2 : 538.27

21090 RELATIVE INTENSITIES OF ZEEMAN COMPONENTS IN NUCLEAR QUADRUPOLE RESONANCE SPECTRUM.

M.Toyama.
J. Phys. Soc. Japan, Vol. 14, No. 12, 1727-38 (Dec., 1959).

The transition probabilities for the Zeeman components in nuclear quadrupole resonance spectrum were formulated in the case of arbitrary field gradient. Interesting behaviour was revealed especially for a nucleus of half-integral spin. When a magnetic field is applied in a direction perpendicular to the principal z-axis in the case of nonaxial field gradient due to the surrounding charges, the inner pair of the Zeeman components is produced by the x-component of the r.f. field and the outer pair by the y-component. The dependence of the intensities on the Zeeman field is in general not symmetric with respect to the principal axes of the field gradient.

539.2 : 538.27

21091 QUADRUPOLE NUCLEAR MAGNETIC RESONANCE EFFECTS IN MIXED $NaNO_3$—$AgNO_3$ CRYSTALS.

M.I.Kornfel'd and V.V.Lemanov.
Zh. eksper. teor. Fiz., Vol. 39, No. 1(7), 53-6 (July, 1960). In Russian.

The intensity of the satellites was studied as a function of $AgNO_3$ content. The validity of the critical sphere model is demonstrated and its radius determined and found to equal 13 A.

539.2 : 538.27

21092 SECOND-ORDER QUADRUPOLE EFFECTS IN SODIUM NITRATE.

V.V.Lemanov.
Zh. eksper. teor. Fiz., Vol. 39, No. 2(8), 260-1 (Aug., 1960). In Russian.

A shift of the central nuclear magnetic resonance line of Na^{23} caused by second-order effects was observed in sodium nitrate single crystals. The sign and magnitude of the shift is the same as that predicted by calculations.

539.2 : 538.27 : 536.48

NUCLEAR QUADRUPOLE RESONANCE IN SUPERCONDUCTING GALLIUM. See Abstr. 19562

MECHANICAL PROPERTIES OF SOLIDS

539.3

21093 THE FUNDAMENTAL EQUATIONS OF THE THEORY OF THE ELASTICITY OF A MEDIUM OF PARTICLES WITH ROTARY INTERACTIONS.

É.L.Aéro and E.V.Kuvshinskii.
Fiz. tverdogo Tela, Vol. 2, No. 7, 1399-1409 (July, 1960). In Russian.

Since there are certain phenomena which the theory of elasticity based on a system of point particles is unable to account for, a theory based on large particles which can be both rotated and translated is developed. A deformed state must be characterized both by the stress tensor and by the tensor which gives the local torque. Equations of motion are derived by writing the energy in terms of the "pure" deformation tensor and the tensor of local twisting and bending. The elastic potential for small deformations is derived and Hooke's law obtained from it. The Saint-Venant identities relating components of the two types of stress tensor are found. D.J.Thouless

539.3

21094 ELASTIC STIFFNESS CONSTANTS OF CADMIUM SULFIDE.

T.Masumi and T.Tanaka.
J. Phys. Soc. Japan, Vol. 14, No. 10. 1313-15 (Oct., 1959).

The elastic stiffness constants $\| c_{ij} \|$ of wurtzite type cadmium sulphide single crystals were determined on several cube specimens at room temperature by the ultrasonic pulse echo method at 5.0 and 10 Mc/s. The results are; $c_{11} = 0.778$; $c_{12} = 0.447$; $c_{33} = 0.881$; $c_{44} = 0.147$; $c_{66} = 0.159$, in units of 10^{12} dynes per cm^2, using the value of density $\rho = 4.83\ g/cm^3$.

539.3 : 539.2

ELASTIC CONSTANTS OF SODIUM IODIDE AT LOW TEMPERATURES. See Abstr. 17895

539

21095 VARIATION WITH TEMPERATURE OF YOUNG'S MODULUS OF POLYCRYSTALLINE GRAPHITE.

I.B.Mason and R.H.Knibbs.
Nature (London), Vol. 188, 33-5 (Oct. 1, 1960).

It was shown by measurement of Young's modulus between ro temperature and 1000°C that the variation with temperature is not always positive. A minimum at about 200°C was found. The resu for different heat-treatments were shown in a figure, experimenta details were given. Explanations by other authors were discussed (1) the positive variation results from recovery of stresses introduced during manufacturing and subsequent cooling; or (2) a tighte ing of the structure occurs on heating by the large c-axis expansic of the crystallites. Objections to (1) were: (a) that any internal stresses would cease to be effective below 200°C; (b) the cooling during measurement is faster than after final heat treatment; (c) t experiments showed that the higher heat treatment temperatures d not result in steeper modulus variations. Though there are object to the second hypothesis it seemed to be favoured by experimental results. A comparison between Young's modulus and thermal expansion showed a great similarity in the shapes of the curves. Further investigations in the low-temperature region and with a variety of source material were intended. H.E.Schm

539

21096 THE EFFECTS OF SURFACE CONDITION ON THE MECHANICAL PROPERTIES OF LITHIUM FLUORIDE CRYSTALS.

A.R.C.Westwood.
Phil. Mag. (Eighth Ser.), Vol. 5, 981-90 (Oct., 1960).

A comparative study was made of the mechanical behaviour of as-cleaved, chemically polished and coated lithium fluoride crysta Surface coatings were produced by vacuum deposition and by chemical reaction. Thin ($\not> 10\ \mu$) reacted coatings increased the yield stress some 50% and were responsible for catastrophic stress dro observed at the critical resolved shear stress. Coatings also decreased the initial rate of work-hardening and the stress and strai to fracture. Failure occurred by the formation of Stroh-type crac An explanation for these and other results is offered based on considerations of the distribution and number of operable dislocation sources, and the piling up of dislocations at intersecting slip bands and beneath surface films. Metallographic evidence is presented for the latter phenomena. Experimental observations are more co sistent with a barrier-mechanism of work-hardening than with a defect-mechanism.

539

21097 THE EFFECT OF IMPURITIES ON THE STRENGTH O SILVER CHLORIDE.

W.J.Luhman and A.E.Gorum.
Acta. metallurgica, Vol. 7, No. 10, 685-7 (Oct., 1959).

Stress-strain characteristics were obtained for AgCl containi up to 10% AgBr, 10% $CuCl_2$, 1% AgI and 0.1% $NiCl_2$, and were foun to be similar to those in metal solid solution systems.

R.F.Pea

53

21098 INTERNAL FRICTION OF KCl CRYSTALS AT LOW TEMPERATURES.

T.Suzuki, K.Suzuki and T.Kamigak
J. Phys. Soc. Japan, Vol. 14, No. 6, 731-40 (June, 1959).

Ultrasonic attenuation in the megacycle range for cold-worke and for quenched KCl crystals was measured between 200°K and room temperature. A very broad relaxation band appears below 240°K for cold-worked crystals. The experiments on the anisotropy of attenuation in crystals cold-worked by uniaxial compression demonstrate that the attenuation is caused by the motion of the dislocations. The activation energy is found to be 0.44 eV. Quenched crystals show a similar band. The following unique features are found: as the quenching temperature is raised the attenuation band shifts to a higher temperature. This shift is accompanied by an increase of the activation energy. Another significant feature is the ageing effect, which also results in a band-shift to a higher temperature with increasing ageing time after quenching. It was shown that the effect of vacancies in the dislocation core upon the activation energy for the motion of dislocations and the concurrent motion of vacancies in the cores of oscillating dislocations both give rise to such a broad band as observed.

539

21099 THE OBSERVATION OF SHARP INTERNAL FRICTIO PEAKS IN BERYLLIUM.

E.W.Dickson.

l. Mag. (Eighth Ser.), Vol. 5, 325-33 (April, 1960).
Measurements were made as a function of strain and tempera-
e with specimens of commercially pure beryllium. Very sharp
rnal friction peaks were observed which are similar to those
orted as occurring in aluminium. The previously suggested
chanism giving rise to these maxima is discussed in terms of the
dence obtained here.

539.3

1100 SOME EFFECTS OF VIBRATION ON THE INTERNAL FRICTION OF SODIUM CHLORIDE.

R.W.Whitworth.

l. Mag. (Eighth Ser.), Vol. 5, 425-40 (May, 1960).
The room temperature internal friction of single crystals of
l vibrating at a frequency of 90 kc/s was measured at strain
plitudes up to 2.7×10^{-4}. The damping of plastically deformed
stals increased with increasing strain amplitude, and can be
ibuted to the motion of the dislocations introduced by the defor-
tion. Vibration of specimens at high amplitudes changed their
rnal friction in three distinct ways. (a) When deformed speci-
ns were annealed at 100° to 200° C the internal friction was re-
ed, but subsequent vibration at high amplitudes caused the
nping to rise towards its value before annealing. (b) While
tly deformed crystals were being driven at very high amplitudes
damping was observed to decrease; the value at low amplitudes
s afterwards found to be less than that determined before this
ration. (c) At the highest amplitudes attained in these experi-
nts, new dislocations were produced in the crystals, and their
sence was shown by etching experiments; an increase in the
nping was associated with the introduction of these dislocations.
ese observations are discussed in terms of current theories.

539.3

21101 THE INFLUENCE OF SOLUTE ATOMS ON THE DAMPING DUE TO DISLOCATIONS IN IRON ALLOYS.

M.Robinson and R.Rawlings.

il. Mag. (Eighth Ser.), Vol. 4, 938-47 (Aug., 1959).
The effect of silicon and oxygen in solid solution on the damping
iron (vibrating at 1.03 c/s) was studied. The damping is inde-
ndent of vibrational amplitude up to a critical amplitude. The
riation of this critical amplitude with temperatures and solute con-
ntration was studied. From the temperature variation of the
itical amplitude a binding energy of 0.004 eV between a silicon
m and a dislocation was obtained. Above the critical amplitude,
damping varies with amplitude of vibration. This variation is
mpared with that deduced by Granato and Lücke's (1956) model
mechanical damping due to dislocations.

539.3

21102 DYNAMIC MEASUREMENT OF ELASTICITY USING RESONANCE METHODS.

G.Bradfield.

rit. J. appl. Phys., Vol. 11, No. 10, 478-80 (Oct., 1960).
Several arrangements are described in which magnetostrictive
ansducers in the form of either wire or thin tube have been used
r exciting and detecting resonances. The advantages of such
ystems are indicated.

A.E.Kay

539.3 : 536.63

21103 SOME ELASTIC AND THERMAL PROPERTIES OF ZIRCONIUM AND TUNGSTEN.

A.Myers.

hil. Mag. (Eighth Ser.), Vol. 5, 927-38 (Sept., 1960).
The longitudinal and shear wave velocities of 10 Mc/s ultrasonic
aves were measured in polycrystalline specimens of zirconium and
ngsten at temperatures between 14° and 300° K and the elastic con-
ants calculated from these measurements. The difference between
e specific heats at constant pressure and at constant volume in
ese metals at various temperatures was calculated by means of
e thermodynamic relation involving the bulk modulus of the metal;
is difference was used in the examination of a suggested method of
taining the γ-values, and hence the electronic specific heats of
etals. It is found that the γ-values for zirconium and tungsten
stimated by this method are greater by factors of about 1.3 and
.8 respectively than the values obtained from low-temperature
alorimetric determinations. For a number of reasons, which are
scussed, close agreement is not to be expected but no satisfactory
xplanation for the very wide discrepancy was found.

539.3

21104 STUDIES OF COPPER TARGETS ATTACKED BY SHAPED CHARGES.

A.Soundraraj.

cta metallurgica, Vol. 7, No. 11, 752-4 (Nov., 1959).

Samples of Cu of 99.8% purity were subjected to attack by jets emanating from "shaped" charges — charges with metal-lined cavities. These samples were examined metallographically and, from the changes noted, inferences were drawn as to the cause and type of deformation occuring at various points and under various conditions.

J.Thewlis

539.3

21105 CREEP IN FACE-CENTRED METALS AND SOLID SOLUTIONS WITH SPECIAL REFERENCE TO α-BRASSES.

P.Feltham and G.J.Copley.

Phil. Mag. (Eighth Ser.), Vol. 5, 649-67 (July, 1960).

The creep of α-brasses containing 10-35% Zn was studied in the range 350°-650° C. The equilibrium creep rate satisfied the relation $\dot{\epsilon} = A_0(T) \exp(-H/kT) \sinh (q\sigma/kT)$, but two sets of the parameters A_0, H and of the activation volume q associated with the tensile stress σ were required, one above and one below a critical stress $\sigma_C'(T)$ above which Cottrell—Lomer locking appeared to become a less effective impediment to slip than at lower stresses. A peak in the activation energy H' (below σ_C') close to the composition represented by Cu_3Zn is interpreted in terms of local order near dislocation cores. This affects the migration of jogs and hence recovery by climb. Below σ_C' H is equal to 1.6 times the activation energy for grain boundary self-diffusion. Two models are proposed in which the climb of dislocations over intragranular obstacles or within grain boundaries are rate determining, depending on whether $\sigma < \sigma_C'$ or $\sigma > \sigma_C'$. The temperature dependence of A_0', A_0, q' and q is explained on the basis of the assumption that the dimensions of the intragranular substructure developing during creep attain lower limiting values which, at any given temperature, depend only on σ_C'.

539.3

21106 SOME NEW YIELD PHENOMENA IN MOLYBDENUM.

A.A.Johnson and D.E.Peacock.

Phil. Mag. (Eighth Ser.), Vol. 4, 528-30 (April, 1959).

Molybdenum rods were prestrained and then retested after annealing for one hour at temperatures up to 750° C. The initial straining showed a yield point and a step in the Lüders straining region. On retesting the yield point reappeared only after annealing above 570° C, but there was always a step in the Lüders region.

H.Mykura

539.3

21107 YIELD POINT PHENOMENA IN ALPHA BRASS AND OTHER FACE-CENTRED CUBIC METALS.

G.F.Bolling.

Phil. Mag. (Eighth Ser.), Vol. 4, 537-59 (May, 1959).

The characteristics of yield points which may be produced in a 70 : 30 alpha brass were observed at several temperatures. The yield point phenomena were produced by various techniques which included ageing under stress, unloading and combinations of the two. The effects arising from ageing under stress are compared to experiments on repeated yielding. The particular results in brass are supported by various experiments with a range of face-centred cubic metals. From the evidence presented it seems that the process of ageing is more complex than hitherto supposed.

539.3

21108 THE YIELD POINT OF A SUPER-LATTICE.

N.Brown.

Phil. Mag. (Eighth Ser.), Vol. 4, 693-704 (June, 1959).

A completely theoretical calculation was made of the dependence of the yield point on the degree of long-range order in an AB b.c.c. super-lattice. The resulting equation is

$$\tau = NkTS_0^2/4b$$

where T is temperature, and S_0 is degree of long-range order. For β-brass a maximum in τ at 515° K of 0.54×10^9 dynes/cm² is predicted; the experimentally observed values are 493° K and 0.36×10^9 dynes/cm². A sharp increase in τ was observed near T_C; it is associated with short-range order strengthening as predicted by Sumino. The width of an anti-phase domain boundary also calculated. For $T > 0.5\,T_C$ the width is given by the equation

$$\text{width} = \tfrac{1}{2}\pi[T_C/(T_C - T)]^{1/2} + \tfrac{1}{2}.$$

539.3

21109 EFFECT OF TEMPERATURE ON YIELD AND FLOW STRESS OF B.C.C. METALS. H.Conrad.

Phil. Mag. (Eighth Ser.), Vol. 5, 745-51 (July, 1960).

A comparison of data on yielding and flow of b.c.c. metals indicates that the proportional limit, the lower yield stress, the friction stress of Heslop and Petch, and the flow stress after some strain beyond the Lüders strain all exhibit the same strong temperature dependence. This suggests that they all represent the same deformation mechanism. Furthermore, in iron the temperature dependence of these parameters depends on the total interstitial content and on the presence of grain boundaries. Only when both are present does one observe the very strong temperature dependence normally associated with commercial irons and steels.

539.3

21110 REVERSE BENDING OF CRYSTALS OF SILVER CHLORIDE. M.T.Sprackling.

Phil. Mag (Eighth Ser.), Vol. 5, 441-4 (May, 1960).

The reverse bending of single crystal bars of silver chloride that were already singly bent was studied using the photoelastic effect. There is no indication of the preferential deformation at a certain plane on the bar found when annealed crystals are bent. This is also true if the crystals are first heated at temperatures between room temperature and 375° C, but if they are heated at higher temperatures and as a result all detectable long-range stresses are removed from the crystal the sharp yield point of the first bending is recovered. The results are considered in terms of a simple dislocation model.

539.3

21111 BAUSCHINGER'S EFFECT DURING FRICTIONAL SLIP. A.S.Radchik and V.D.Evdokimov.

Dokl. Akad. Nauk SSSR, Vol. 134, No. 3, 571-3 (Sept. 21, 1960). In Russian.

Specimens pulled up to the plastic limit, then strongly compressed and pulled again, show a smaller elastic limit (Bauschinger's effect). This effect is investigated in metal surfaces subjected to uni- and bi-directional friction; it is interpreted in terms of thickness of plastic surface layer and of its micro-hardness, which are illustrated.

J.K.Skwirzynski

539.3

21112 AN EXPERIMENTAL INVESTIGATION ON THE MODE OF SLIP IN FACE-CENTERED CUBIC METALS.

T.Taoka, K.Yasukochi, R.Honda and I.Oyama.

J. Phys. Soc. Japan, Vol. 14, No. 7, 888-94 (July, 1959).

The changes of saturation of magnetization of the ordered Ni_3Mn and Pt_3Co alloys caused by plastic deformation were used as the criterion to decide whether the slip in metals is "homogeneous" or "inhomogeneous", i.e., whether it takes place in atomic steps on many successive atomic planes or in large steps on widely separated single atomic planes. It was found that in the ordered Ni_3Mn alloy, the saturation magnetization decreases with the amount of elongation at room temperature, while in the ordered Pt_3Co alloys, the intensity of magnetization at temperatures near the Curie point increases with the amount of compression. These changes, which are roughly proportional to the amount of deformation, are probably understood only from the point of view that new disordered regions with Curie points different from that of the ordered state are produced during the deformation, being associated with homogeneous slip on successive atomic planes.

539.3

21113 THE EFFECT OF SURFACE FILMS ON THE SLIP OF SUBSTRATES. T.Evans and D.R.Schwarzenberger.

Phil. Mag. (Eighth Ser.), Vol. 4, 889-98 (Aug., 1959).

The influence of surface polycrystalline films of carbon, platinum, iron and chromium on the slip distribution of deformed single crystal specimens of silver was examined by electron microscopy using a new technique. A thin oriented film of gold was was evaporated on the surface of silver specimens and the polycrystalline film deposited on the gold film. After deformation of the specimens and subsequent stripping of the composite films, the gold film has given information about the slip distribution in the substrate which has been found to be influenced by the presence of the surface polycrystalline film. It is proposed that this influence depends upon the adhesion between the surface film and the substrate and also the mechanical properties of the film itself.

21114 THERMALLY ACTIVATED GLIDE IN FACE-CENTR CUBIC METALS AND ITS APPLICATION TO THE THEORY OF STRAIN HARDENING. Z.S.Basinski.

Phil. Mag. (Eighth Ser.), Vol. 4, 393-432 (April, 1959).

The influence of temperature and strain rate on the flow str of polycrystalline aluminium, copper and silver was studied. Tensile tests were carried out a various temperatures down to 1.7° K. The results indicate that t reversible change of flow stress (after correction for variation elastic modulus in experiments involving temperature change) results from the thermally activated surmounting of barriers by glide dislocations. The main barriers are believed to be forest dislocations cutting the glide plane. The variation of the force between a dislocation and an obstacle with their separation was derived for the three metals; the values agreed well with the expected forms. The maximum force can be computed if the distan at which the force rises steeply is assumed to be equal to the Burgers vector; the values are, for aluminium, 3.5×10^{-5} dynes and for copper, 6.3×10^{-5} dynes. It has been shown that the inte stress varying over distances larger than the separation between successive dislocations emitted from the same source will not co tribute appreciably to the hardening, and that the most important source of hardening is the dislocation forest. This is borne out by the fact that the flow stress ratio is approximately the same f polycrystalline and single crystal specimens of aluminium defor both in tension and torsion, and also for commercially pure alum ium. The rate of strain hardening in the linear region has been calculated using the above assumptions, and agrees well with exp mental data.

539.3 : 539.2 : 538.

STRAIN-BROADENING OF NUCLEAR MAGNETIC RESONANCE LINES IN COPPER. See Abstr. 21083

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21115 DEFORMATION TWINNING OF TIN SINGLE CRYSTA UNDER IMPACT LOADING. K.Ishii.

J Phys. Soc. Japan, Vol. 14, No. 10, 1315-21 (Oct., 1959).

Impact tests were carried out on the mechanical twinning of 99.98% pure tin crystals, the time of stressing being 10^{-3} sec. The twinning occurred with a sharp yield process, when the [001] axis was nearly perpendicular (±15°) to the specimen axis. The upper yield stress varied from 0.7 to 2.5 kg/mm², while the lowe yield stress and also the stress for the further thickening of the generated twin lamella were from 0.1 to 0.2 kg/mm². Twinning occurred where large local stress was expected. The critical sh stress law holds approximately for the upper yield stress after indentation, the stress being 0.8 ± 0.1 kg/mm². Two explanations are put forward for the results on the upper yield stress for twinning.

539

21116 ON A NEW MODE OF DEFORMATION IN INDIUM ANTIMONIDE. J.W.Allen.

Phil. Mag. (Eighth Ser.), Vol. 4, 1046-54 (Sept., 1959).

Dislocations can be introduced into indium antimonide by loc impact. The particular configuration of dislocations produced ha been called a "dislocation-crack", because of its close resemblan in macroscopic features to an ordinary crack. The stress requir to produce a dislocation-crack is shown to be of the same order a the fracture stress. A mechanism which explains the observation is proposed. Dislocation-cracks also occur in InAs, GaAs, GaP a Ge.

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21117 AN ELECTRON MICROSCOPE STUDY OF STAINLES STEEL DEFORMED IN FATIGUE AND SIMPLE TENSION. P.B.Hirsch, P.G.Partridge and R.L.Segall.

Phil. Mag. (Eighth Ser.), Vol. 4, 721-9 (June, 1959).

A technique is described whereby the surface of metal specimens can be examined by transmission electron microscopy The original specimens are thinned by electropolishing from one side; thus the surface contours, e.g. slip steps, are preserved on of the surfaces. It is shown that dislocations are revealed associ with the surface slip lines; the step heights and surface contours as those of fatigue striations are observed at a high magnification to a taper section effect.

539.3

1118

DISLOCATION ARRANGEMENTS IN ALUMINIUM DEFORMED IN TENSION OR BY FATIGUE.

Segall and P.G.Partridge.
. Mag. (Eighth Ser.), Vol. 4, 912-19 (Aug., 1959).

A comparison was made of transmission electron microscope ervations on polycrystalline aluminium deformed in tension or atigue. The dislocation distribution in aluminium deformed in ion was studied as a function of stress. At stresses up to mm^{-2} the distribution is extremely irregular; at higher stresses o the fracture stress, polygon boundaries are formed which be- e increasingly well developed with increasing stress. Obser- ons were made on specimens fatigued at high stress, giving a of 10^5 cycles, and low stress, giving a life greater than 10^8 es. The dislocation distribution in the former is similar to in the unidirectionally deformed specimens. The low stress gue specimens show two new features. Firstly, polygonization s not occur despite a high dislocation density, and secondly a density of dislocation loops similar to that found in quenched cimens is observed in some areas. The latter observation gests the formation of large numbers of point defects during gue.

539.3

21119

DEPENDENCE OF THE DAMPING DECREMENT ON THE TOTAL NUMBER OF CYCLES IN FATIGUE STS.

I.I.Soloshenko.
tverdogo Tela, Vol. 2, No. 8, 1864-8 (Aug., 1960). In Russian.

The logarithmic decrement was measured as a function of the nber of completed cycles during a fatigue test at 1 c/s of a rock- t crystal. The results show that the process of fatigue failure be divided into five parts: (a) hardening, (b) long term work in hardened state, (c) appearance of embryonic cracks, (d) deve- ment of cracks, (e) failure. R.F.S.Hearmon

539.3

21120

FATIGUE DAMAGE AND CRACK FORMATION IN PURE ALUMINIUM.

D.R.Harries and G.C.Smith.
Inst. Metals, Vol. 88, Pt 4, 182-5 (Dec., 1959).

A statistical study was made of the effects of intermediate iealing on fatigue life of aluminium specimens tested in alternating sion. Annealing at various stages of the fatigue life proves to have significant effect on the total life to fracture. However, periodic noval of the surface layers during the test enables the fatigue life be extended considerably. It is concluded that fatigue cracks tiate at the free surface of an even, axially stressed specimen. is is probably due to differences in the modes of deformation of surface and the interior and not to the corrosive effect of the nosphere.

539.3 : 539.2

21121

MOVEMENT OF POINT DEFECTS DURING FATIGUE OF ALUMINIUM CRYSTALS.

Roberts and R.W.K.Honeycombe.
il. Mag. (Eighth Ser.), Vol. 5, 1147-9 (Nov., 1960).

The dynamic stress—strain behaviour of aluminium crystals igued in a push—pull machine at 13 c/sec is outlined. Room mperature interuptions of tests carried out at −196°C, −78°C d 20°C resulted in a transitory hardening which is attributed to e movement of point defects to dislocations.

539.3

21122

MECHANICAL PROPERTIES OF SOLIDS AT 4.2°K AND BELOW. V. THE EFFECT OF PRELIMINARY LASTIC DEFORMATION ON THE MECHANICAL PROPERTIES OF LUMINIUM, COPPER AND NICKEL.

O.V.Klyavin.
z. tverdogo Tela, Vol. 2, No. 8, 1891-9 (Aug., 1960). In Russian.

Reports the effect of preliminary extension at 1.6-4.2°K or 0°K on the mechanical strength and plasticity (at 1.6-4.2 or 300°K) polycrystalline 99.3% pure aluminium, 99.9% copper and 99.94% ckel in annealed and non-annealed states. A.Tybulewicz

539.3

21123

TIME AND TEMPERATURE DEPENDENCE OF THE ULTIMATE PROPERTIES OF AN SBR RUBBER AT ONSTANT ELONGATIONS.

T.L.Smith and P.J.Stedry.
. appl. Phys., Vol. 31, No. 11, 1892-8 (Nov., 1960).

The ultimate properties of amorphous rubbers at temperatures bove T_g are considered in terms of stress—strain curves to rupture measured at different strain rates and temperatures. The consideration indicates that a specimen held at a fixed elongation should break eventually, provided the elongation exceeds a critical value. This expected behaviour was found by studying an SBR rubber. For samples maintained at different elongations for up to seven days, both the time to break and the stress at break were measured at eight temperatures from 1.7° to 60°C. For comparison, the ultimate properties were also measured at different strain rates and temperatures. The comparison indicates that for a given ultimate elongation and stress at break, the time to break under conditions of constant elongation is less than under conditions of constant strain rate.

539.3

21124

INVESTIGATION OF THE ANNEALING OF NICKEL DEFORMED BY COMPRESSION BY X-RAY AND STORED ENERGY MEASUREMENTS.

D.Michell and E.Lovegrove.
Phil. Mag. (Eighth Ser.), Vol. 5, 499-518 (May, 1960).

X-ray diffraction patterns from bulk specimens of nickel deformed by compression were measured with a Geiger-counter spectrometer. A composite specimen was used to overcome the effects of preferred orientations. The results indicate that during the annealing there is no change in the background intensity. No evidence was found for stacking faults or changes in lattice parameter. The integrated intensities of all lines remain constant up to a temperature of annealing of about 480°C. A large decrease (30-75%) in the integrated intensity of all lines occurs on annealing to 600°C and this is attributed to extinction; an estimate of 2-4 μ is obtained for the size of the "perfect" regions required to produce this effect. The diffraction profiles are analysed by a number of methods. The broadening produced by the particle size effect is small. The stored energies derived from the various methods of analysis range from 0.04-2.4 cal/g. Best agreement is obtained between values of stored energy measured using a calorimetric method (0.28 cal/g) and those derived from X-ray measurements if it is assumed that the distribution of strain is Gaussian.

539.3

21125

ON THE RELEASE OF COLD-WORK IN CADMIUM IN TERMS OF MECHANICAL PROPERTIES.

R.Kamel and E.A.Attia.
Phil. Mag. (Eighth Ser.), Vol. 4, 644-53 (May, 1959).

Three principal recovery processes were investigated by isothermal internal friction and elasticity measurements on heavily cold-worked Cd samples which had been annealed at various temperatures up to 280°C. The first recovery process is room temperature recovery and was observed immediately after shear deformation. The second process was studied after annealing below the re-crystallization temperature which is about 150°C, while the third was investigated above 150°C. A tentative explanation is given for the structural changes that take place during the induction period which is activated with an energy of 32 ± 2 kcal/mole, and is possibly due to the recombination of extended dislocations with change in the orientation of the crystallites formed on deformation. It is concluded that for samples pre-annealed at temperatures lower than that of re-crystallization, re-crystallization is more likely to proceed by the growth of the particles formed on deformation.

539.3

21126

UNLOADING EFFECTS IN ALUMINIUM AND ALUMINIUM—ZINC SINGLE CRYSTALS.

A.T.Thomas.
Phil. Mag. (Eighth Ser.), Vol. 5, 947-66 (Sept., 1960).

Interrupted tensile tests were carried out on single crystals of superpurity aluminium and aluminium—zinc solid solutions. Partial load removal during an interruption of the test was shown to have several effects on subsequent plastic flow. Unloading yield points were formed during tests on both alloy and aluminium speciments, while strain-ageing yield points formed during tests on alloy specimens were shown to be either enhanced or diminished, depending on the sequence of prior ageing and unloading. Finally, the relationship between unloading and room temperature recovery is examined and the results suggest that the trapping of glissile dislocations, as a result of unloading, leads to a partial suppression of recovery.

539.3

21127

THE PLASTICITY OF ALKALI HALIDE CRYSTALS.

G.A.Bassett.
Acta metallurgica, Vol. 7, No. 11, 754-5 (Nov., 1959).

Reports experiments which provide some support for the view that a reaction between the crystal surface and atmospheric components markedly influences the generation and motion of dislocations in rocksalt. Closely and uniformly spaced slip steps (mean spacing 60 A) were observed on the tension face of bent crystals whose faces had been freshly cleaved. Unit slip was thought to have occurred on each operative slip plane. Crystals aged in air before bending do not show this sort of deformation. W.Bardsley

539.3

21128 THE NATURE OF SHEAR FORMATION IN THE FLOW AREA OF METALS.

N.N.Davidenkov and É.I.Brainin.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1816-17 (Aug., 1960). In Russian.

Flow of metals may lead to directed shear formation, with a break in the initially rectilinear axis of the specimen. A formula is derived connecting the relative extension with the rotation and is shown to agree with experimental results. R.F.S.Hearmon

539.3

21129 RHEOLOGICAL EQUATION OF VOIGTIAN MATERIAL.

W.Segawa.

J. Phys. Soc. Japan, Vol. 14, No. 8, 1102-6 (Aug., 1959).

The classical one-dimensional rheological equation of Voigtian material having a single retardation time is extended so as to be applicable to a large, three-dimensional deformation; Lagrange's and Euler's representations are explicitly used. The rheological equation in Euler's representation is reduced to the most general stress–strain relation described by Rivlin (derived by a general procedure using the elastic theory of finite deformation), when its terms relating to viscosity are eliminated; it is reduced to the most general stress–strain rate relation derived by Reiner and Rivlin, when its terms relating to elasticity are omitted. The present equation is applied to a simple elongation and a simple shear problem, with satisfactory results.

539.3

21130 X-RAY LINE BROADENING IN PLASTICALLY DEFORMED CALCITE.

M.S.Paterson.

Phil. Mag. (Eighth Ser.), Vol. 4, 451-66 (April, 1959).

The broadening of several X-ray powder lines of calcite as a result of plastic deformation under a high confining pressure was studied in Solenhofen limestone. The dependence of the broadening on the Bragg angle, the apparent influence of elastic anisotropy and the results of Fourier analysis of the lines suggest that the broadening is due mainly to internal strains. The stored energy associated with the internal strains is estimated to be an appreciable fraction, possibly one half or more, of the energy (about 10 cal g^{-1}) expended during deformation. The amount of broadening and the estimated stored energy are relatively large in comparison to the values for most deformed metals. There is no evidence for the presence of stacking faults.

539.3

21131 THE LATTICE THERMAL CONDUCTIVITY OF COPPER ALLOYS: EFFECT OF PLASTIC DEFORMATION AND ANNEALING.

W.R.G.Kemp, P.G.Klemens and R.J.Tainsh.

Phil. Mag. (Eighth Ser.), Vol. 4, 845-57 (July, 1959).

The thermal and electrical conductivities were measured and the lattice thermal conductivities were deduced of two copper alloys (Cu-0.4% As and Cu-32% Zn) after severe torsional deformation and after subsequent annealing. Deformation and annealing conditions were selected to allow comparison of these measurements with studies of the release of stored energy made by Clarebrough, Hargreaves, Loretto, and West. In the case of arsenical copper the only observable change in lattice thermal conductivity is due to a removal of dislocations during the recrystallization stage. In the case of α-brass, the recovery phenomena are complex and not fully understood; annealing seems to remove dislocations, point defects, and probably also stacking faults. Dislocation densities deduced from the lattice thermal conductivity appear to be somewhat higher than those deduced from stored energy release and from changes in the density.

539.3

21132 COMMENTS ON THE RECENT PAPER OF CLAREBROUGH, HARGREAVES AND LORETTO.

R.O.Williams.

Acta metallurgica, Vol. 7, No. 10, 676-7 (Oct., 1959).

Compares measurements by Clarebrough et al. [Acta metallurgica, Vol. 6, 725 (1958)] of the energy stored in plastically deformed metal with earlier work. Concludes that the results are less accurate than the authors claim, and that more experimental results are needed, particularly at low strains. H.Mykura

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21133 THE PLASTIC DEFORMATION OF SINGLE CRYSTA OF AN ALUMINIUM–SILVER ALLOY.

A.Kelly, A.Lassila and S.Sato.

Phil. Mag. (Eighth Ser.), Vol. 4, 1260-77 (Nov., 1959).

Tensile tests were carried out at a variety of temperatures between 77° and 373°K on single crystals of an aluminium – 20 silver alloy. The crystals were aged either at room temperatur or at 160°C within the cold-hardening range. Single crystals of material are very ductile. Stress–strain curves were obtained the change of flow stress with temperature, during deformation, measured and compared with the change of elastic modulus over same temperature range. Observations were made with the opti microscope of the appearance of slip lines on polished surfaces the specimens. The stress-strain curves are approximately lin showing a rate of work hardening about the same as that of pure aluminium in stage II of the stress–strain curve. The temperat dependence of the flow stress is small, varying less than does th elastic modulus over the temperature range investigated. The temperature dependence of the flow stress is compared with new measurements of the same quantity in pure aluminium single crystals. The crystals deform by a ⟨110⟩ {111} slip mechanism cross slip is profuse at all stages of the deformation and at all temperatures. This is attributed to the very high flow stress of these single crystals which is two orders of magnitude greater th that shown by pure aluminium.

539

21134 NOTE ON A PRINCIPAL AXIS PROBLEM IN PLAST CITY THEORY.

H.Ziegler.

Z. angew Math. Phys., Vol. 11, No. 2, 157-63 (March 25, 1960). German.

In an ideally plastic material any principal axis of the stress tensor is also a principal axis of the strain rate tensor. It is sho here that in plastic flow also the reverse is true. Besides, the validity of either statement is discussed for materials obeying Prager's hardening rule or its modification proposed by the auth

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21135 TEMPERATURE–TIME DEPENDENCE OF THE STRENGTH OF SILVER CHLORIDE.

S.N.Zhurkov, B.Ya.Levin and T.P.Sanfirova.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1040-2 (June, 1960). In Russia

The relation between the duration of stress τ, the breaking stress σ and the temperature T for 1 mm thick specimens was fo to be $\tau = \tau_0 \exp[(U_0 - \gamma\sigma)/kT]$ where $\tau_0 \cong 10^{-12}$ sec, U_0= 31 kilocalo mole and γ depends on the heat treatment to which the specimen subjected. S.Cho

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21136 KINETIC THEORY OF STRENGTH.

L.É.Gurevich and V.I.Vladimirov.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1783-92 (Aug., 1960). In Russi

A theory of the rupture process in solids is proposed, based the assumption that cracks are formed at the ends of slip bands the intergranular layers. The subject is discussed under the headings: strength of solid bodies (Griffiths theory, sustained strength hypothesis, dislocation theory); stress concentration in layers; energetic efficiency of embryonic cracks; time required for rupture of the specimen. See also Abstr. 2690 of 1958; 3155, 6314 of 1960. R.F.S.Hear

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21137 STRENGTH OF SILICA GLASS.

I.Náray-Szabó and J.Ladik.

Nature (London), Vol. 188, 226-7 (Oct. 15, 1960).

A calculation is made of the theoretical strength of silica gla using atomic parameters which include the number of bridging oxygen ions and the force needed to separate an oxygen atom fron an SiO_4 tetrahedron. The result claimed is 2472 kp/mm^2. D.M.Schla

53

21138 THE STRENGTH OF GLASS FIBRES.

D.G.Holloway.

Phil. Mag. (Eighth Ser.), Vol. 4, 1101-6 (Oct., 1959).

Evidence from some simple experiments suggesting a source important stress raising flaws in the surface of glass fibres is described. It is believed that these flaws are the major ones concerning strength, present in fibres drawn at low temperatures

539.4

139 TEMPERATURE DEPENDENCE OF THE STRENGTH OF ZONE HARDENED ALUMINIUM–SILVER ALLOYS.

Fine.

Mag. (Eighth Ser.), Vol. 4, 1375-7 (Dec., 1959).

Theoretical estimates of the relative free-energy change at rent temperatures on moving an atom from a Guinier–Preston into solution are compared with the flow stress. It is suggested entropy considerations, which affect the free-energy change, may aportant in the temperature variation of the flow stress.

H.Mykura

539.4

140 THE QUESTION OF STRENGTH ANISOTROPY OF CONSTRUCTIONAL MATERIALS. E.I.Brainin.

tekh. Fiz., Vol. 30, No. 8, 1006-7 (Aug., 1960). In Russian.

A formula proposed by Ashkenazi [Zh. tekh. Fiz, Vol. 29, No. 3, March, 1959)]for the variation in strength of orthotropic mate- with orientation is tested against results on cold-rolled steel ected to four different treatments. Agreement between the ıula and experimental results is obtained for only one of the tments and it is concluded that the formula must be used with ion as it is not valid for all materials. R.F.S.Hearmon

539.4

141 STATISTICAL ASPECTS OF FRACTURE IN CONCRETE. I. AN ANALYSIS OF FLEXURAL FAILURE OF TLAND CEMENT MORTAR FROM THE STANDPOINT OF CHASTIC THEORY. M.Hori.

ıys. Soc. Japan, Vol. 14, No. 10, 1444-52 (Oct., 1959).

The theory of stochastic processes is applied to the static ure of non-homogeneous brittle materials such as Portland ent concrete. A large number of flexural failure tests on dard mortar specimens were performed under constant loads ell as under uniformly increasing loads, and the results are ysed statistically from the standpoint of stochastic theory. It ncluded that the scatter observed in the breaking time or the c strength of concrete appears to be a result of inherent acteristics of the material itself associated with a Markoff ess as a kind of rate process.

539.4

21142 THE GROWTH OF GRAIN-BOUNDARY VOIDS UNDER STRESS. D.Hull and D.E.Rimmer.

l. Mag. (Eighth Ser.), Vol. 4, 673-87 (June, 1959).

The effect of combined hydrostatic pressure, P, and of uniaxial sion, σ, on the rupture time of polycrystalline copper wire in temperature range 400° to 500° C was determined. All the speci- ıs broke by intergranular fracture, due to the growth of voids ıg grain boundaries. Preliminary experiments indicated that voids grow by the addition of vacancies under the action of the lied stress. A theory has been developed assuming that failure ults from the growth of void nuclei on the grain boundary, which uires that the activation energy for failure is that of grain ndary diffusion and that the rupture time, t_r, depends only on $-$ P). The experiments show that the activation energy is close he expected value, and provided that σ is constant, t_r agrees with ory. Changes in σ, when $(\sigma - P)$ is constant, affect t_r appreci- y, and the results suggest that many of the void nuclei are stress uced.

539.4

21143 THE RELATIONSHIP BETWEEN PLASTIC FLOW AND THE FRACTURE MECHANISM IN MAGNESIUM OXIDE NGLE CRYSTALS. R.J.Stokes, T.L.Johnston and C.H.Li.

ill. Mag. (Eighth Ser.), Vol. 4, 920-32 (Aug., 1959).

Magnesium oxide crystals plastically deformed under a three- int load develop internal slits coplanar with the (110) slip plane d parallel to the [001] bending axis in the tension region. Using ch pit techniques it was shown that the slits lie along the edge of (110) slip band and are confined between two adjacent orthogonal $\bar{1}$0) slip bands. It is proposed that under certain circumstances ge dislocations moving in one of the $(1\bar{1}0)$ slip planes pile into the rrier provided by a wider (110) slip band and coalesce to form a it nucleus along the lines of intersection. This nucleus lies rallel to the (110) plane and grows by cleavage over this plane til it meets another $(1\bar{1}0)$ slip band where it becomes halted. ıus cracks can be nucleated where slip bands intersect but, more portant, they can also be stabilized by slip bands. If microcracks rm in the early stages of plastic flow their growth is unrestricted d the material is brittle. If the crystal is first plastically deformed to introduce sufficient slip, the growth of the microcracks is impeded in certain directions and they develop into narrow slits. The material is then able to deform even further. The correlation between crystal ductility and the appearance of the fracture surface is consistent with this interpretation. For brittle specimens fracture starts from a point, whereas for ductile specimens the fracture appears to start from one of the narrow slits.

539.4

21144 DUCTILE FRACTURE IN METALS. K.E.Puttick.

Phil. Mag. (Eighth Ser.), Vol. 4, 964-9 (Aug., 1959).

Cup-and-cone fracture in single-phase ductile metals appears to originate at holes formed by drawing away of material from non-metallic inclusions, as suggested by Tipper. In copper, the holes expand under the triaxial stresses in the neck and coalesce in a macroscopic fissure; in α-iron, fine cracks are formed by the stress concentrated at the holes. In coarse-grained material shear cracks are formed on the surface of the neck. Pure polycrystalline aluminium separates at the neck of a tensile specimen by slipping-off along a plane of shear. This is thought to be the usual mode of failure in materials in which work-hardening has been exhausted.

539.4

21145 THE DUCTILE–BRITTLE TRANSITION IN IONIC SOLIDS. T.L.Johnston, R.J.Stokes and C.H.Li.

Phil. Mag. (Eighth Ser.), Vol. 4, 1316-24 (Dec., 1959).

Polished monocrystals of silver chloride, sodium chloride, lithium fluoride and magnesium oxide have been shown to exhibit ductility transitions when loaded by impact bending. The behaviour of silver chloride stood apart from that of the other solids in that the temperature below which it cleaved without macroscopic deformation was less than 0.1 T_m (where T_m is the melting point in degrees Kelvin), whereas the corresponding temperatures for sodium chloride, lithium fluoride and magnesium oxide were in the range 0.6-0.7 T_m. Notched monocrystals of silver chloride exhibited a change in fracture mode from cleavage to shear at a temperature of the order of 0.4 T_m. It is emphasized that the ductility of ionic solids is extremely sensitive to strain rate and the presence of a notch.

539.4

21146 THE ATOMIC MECHANISMS OF FRACTURE. J.J.Gelman and D.S.Lieberman.

Phys. Today, Vol. 12, No. 12, 26-8 (Dec., 1959).

Report of a conference held during the week of 12 April, 1959, at Swampcott, Mass. There were five half-day sessions in which 25 invited papers were presented. This was followed by two days of discussion.

539.4

21147 MICRO-CRACKS AND THEIR RELATION TO FLOW AND FRACTURE IN SINGLE CRYSTALS OF MAGNESIUM OXIDE. F.J.P.Clarke and R.A.J.Sambell.

Phil. Mag. (Eighth Ser.), Vol. 5, 697-707 (July, 1960).

Evidence on mechanisms of fracture in magnesium oxide single crystals subjected to tensile loading is given. As-cleaved crystals contain micro-cracks typically 10^{-4} in. long and slip originating from near these cracks occurs during deformation. At a later stage the cracks grow gradually until they increase to a critical size when catastrophic propagation occurs. If the cracks are removed by polishing ductility is enhanced five to ten times. Some crystals were reactor irradiated to doses in the range 10^{14}-10^{19} n.v.t. (epithermal) and the effects of this treatment on flow and fracture are described and discussed.

539.4

21148 SOME OBSERVATIONS ON THE STRESS-CORROSION CRACKING OF α-BRASS AND SIMILAR ALLOYS.

C.Edeleanu and A.J.Forty.

Phil. Mag. (Eighth Ser.), Vol. 5, 1029-40 (Oct., 1960).

An attempt was made to establish a mechanism for stress corrosion by direct observation on the propagation of cracks in α-brass tested under ammonia. The observations indicate that failure might be described by a two-stage process, of local embrittlement followed by a cleavage-like fracture. Such a model demands that the embrittled zone should have its mechanical properties modified in such a way as to allow a crack to form and reach some critical velocity, whilst the normal unattacked metal should be able to support this free-running crack for extensive failure to occur. These requirements are examined in the light of current ideas on the metal physics of fracture.

539.4 : 531.25

SOME KINETIC CONSIDERATIONS OF THE GRIFFITH CRITERION FOR FRACTURE. See Abstr. 19027-8 9028

539.4

21149 STUDY OF THE VARIATION OF TOUGHNESS WITH TIME AND TEMPERATURE.

S.N.Zhurkov and T.P.Sanfirova.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1033-9 (June, 1960). In Russian.

It was demonstrated in earlier papers (Zhurkov and Narzullaev, Zh. tekh. Fiz., Vol. 23, 1677, 1953; Zhurkov and Sanfirova, Dokl. Akad. Nauk SSSR, Vol. 101, No. 2, 237, March 11, 1955; and Abstr. 4077 of 1959) that the durability (time to rupture) τ, the tensile stress σ and temperature T are related to each other by the expression $\tau = \tau_0 \exp[(u_0 - \gamma\sigma)/kT]$, where τ_0, u_0 and γ are constants related to the strength properties of the given (amorphous or crystalline) solid. In the present research the solids tested were polycrystalline Al and Zn, the grain size being varied by hammer hardening with subsequent recrystallization annealing; the effect of small Mg proportions on the strength of Al was also studied. The tests were carried out on thin test-pieces (uniaxial stretching), and lasted from $\sim 10^{-3}$ sec to several months (see also Zhurkov and Tomashevskii, Zh. tekh. Fiz., Vol. 25, No. 1, 66, Jan., 1955). By varying σ, it was possible to effect variations of τ amounting to 10^9-10^{10}. The fundamental characteristic of variations of durability is the constant γ, which seems to vary approximately as the square root of the grain size (for the same solid). F.Lachman

539.6

21150 THE MECHANISM OF QUENCH-HARDENING AND ITS RECOVERY IN GOLD.

M.Meshii and J.W.Kauffman.

Phil. Mag. (Eighth Ser.), Vol. 5, 939-46 (Sept., 1960).

Resoftening characteristics of quench-hardened gold were experimentally determined. Resoftening occured above 600°C at a highly temperature-dependent rate with an activation energy of 4.7 eV. Various quench-hardening mechanisms are considered. The processes corresponding to the observed characteristics are for quench-hardening: formation of tetrahedral stacking faults; and for resoftening: the nucleation of a Shockley partial dislocation ring on any face of the tetrahedron.

539.6

21151 ON THE KINETICS OF FINE GRINDING OF QUARTZ.

G.S.Khodakov.

Dokl. Akad. Nauk SSSR, Vol. 134, No. 3, 574-7 (Sept. 21, 1960). In Russian.

Based on theoretical considerations, the following expression, describing the kinetics of wet grinding of quartz in an eccentric vibrational mill, was derived: $S = S_m[1 - \exp(-k_2 t)]$, where S denotes the specific surface area of the powder, S_m the specific surface area of that portion of the powder whose particles no longer decrease in size, t the duration of grinding, and $k_2 = kN/V(2.7 \times 10^6 + 4.4 \times 10^9\, l S_m)$, where k is the efficiency of the grinding mill, N its power rating, V the volume of the comminuted material, and l is the thickness of the amorphized surface layers of the quartz particles. The validity of the theoretical formula was confirmed experimentally. M.H.Sloboda

CRYSTALLOGRAPHY

CRYSTAL STRUCTURES

539.2 : 548

21152 TABLES FOR THE CALCULATION OF LATTICE SUMS.

P.Rabinowitz and G.Weiss.

J. chem. Phys., Vol. 33, No. 4, 1272-3 (Oct., 1960).

Lattice sums of the form

$$\Sigma\, j_1^{k} j_2^{l} j_3^{m} (j_1^2 + j_2^2 + j_3^2)^{-p} \exp[i\pi(j_1 x_1 + j_2 x_2 + j_3 x_3)]$$

can be evaluated with the aid of some functions which have been tabulated for this purpose. A.R.Stokes

539.2 :

21153 THERMAL MOTION IN CRYSTALS AND MOLECULE

G.E.Bacon.

Nature (London), Vol. 188, 369-71 (Oct. 29, 1960).

Report of a symposium held at Cambridge on 22-23 Aug., 196 following the fifth international congress of the International Union of Crystallography. There were five invited papers and thirty other contributions. The symposium was aimed at providin discussion of three particular topics: first, the study of elastic and inelastic scattering of X-rays and neutrons by solids, as a source of information on the amplitudes and frequencies of motio in crystals and their dependence on temperature; secondly, the us of electron diffraction measurements to study molecular motions gases; and thirdly, data on residual motion in crystals at low temperatures.

539.2 : 548 : 5

CRYSTALLOGRAPHIC AND MINERALOGICAL PROPERTIES OF TITANIUM OXIDES. See Abstr. 20967

539.2 : 548 : 539.

MICROSTRUCTURE OF NaCl CRYSTALS INVESTIGATED BY ELECTRON MICROSCOPY. See Abstr. 16366

539.2 : 54

21154 FACETS AND ANOMALOUS SOLUTE DISTRIBUTIONS IN INDIUM-ANTIMONIDE CRYSTALS.

K.F.Hulme and J.B.Mullin.

Phil. Mag. (Eighth Ser.), Vol. 4, 1286-8 (Nov., 1959).

Reports the experimental discovery that during the growth of InSb crystals from the melt, the presence of a planar crystallographic {111} facet at the solid–liquid interface can profoundly affect the solute distribution in the growing solid. This effect is due to a real difference in the interface distribution coefficient on and off t {111} facet. The evidence was obtained on pulled crystals with adequate stirring of the melt using Te as solute. W.Bardsl

539.2 : 548.5 : 550

21155 CRYSTAL ORIENTATION IN GLACIER AND IN EXPERIMENTALLY DEFORMED ICE.

G.P.Rigsby.

J. Glaciol., Vol. 3, 589-606 (March, 1960).

More than 8000 ice crystals were oriented and measured for crystal fabric studies from widely separated temperate and polar glaciers, using a large universal stage and thin-section techniques Very strong fabrics were found and a number of laboratory experi ments on deformation and recrystallization of ice were conducted an attempt to solve some of the problems raised concerning glacie flow. In polar glaciers the C– axes of the ice crystals tend to be perpendicular to the foliation plane (alternating planar structures bubbly and clear ice). In areas of high shearing stress the prefer orientation of the axes reached 39% in 1% of the area when plotted on a Schmidt equal-area projection. In temperate glaciers the optic axes tend to form three or four strong maxima which also appear related to the foliation. Patterns from ice deformed in the laboratory resemble some of the fabric patterns found in polar glaciers. During deformation of laboratory specimens, large crys have been observed recrystallizing into many smaller ones, while fine-grained ice, after completion of deformation (both glacier ice and laboratory deformed ice) has been annealed at melting temper ture into a few large crystals with different orientations from the original pattern.

539.2 : 54

21156 DISCUSSION OF "ORIENTATION OF RECRYSTALLIZ GRAINS IN STRAINED ALUMINIUM SINGLE CRYSTA

C.S.Barrett, C.D.Graham, Jr and J.M.Lommel.

Acta metallurgica, Vol. 7, No. 10, 699-700 (Oct., 1959).

Evidence is presented which conflicts with that of Yoshida et. al. (Acta metallurgica, Vol. 7, No. 1, 51, Jan., 1959). It is sugges that the usual methods of producing artificial nucleations do not meet the conditions required for proving the presence of growth selections. R.F.Pe

539.2 : 54

21157 ON TWO DIMENSIONAL NUCLEATION.

J.P.Hirth.

Acta metallurgica, Vol. 7, No. 11, 755-6 (Nov., 1959).

A mathematical treatment of the nucleation rate for two-and three-dimensional nucleation. J.Thewl

539.2 : 548.5

1158

VELOCITY OF LAYER-SPIRAL GROWTH OF CRYSTALS FROM SOLUTION AND FROM THE MELT.

.Chernov.

. Akad. Nauk SSSR, Vol. 133, No. 6, 1323-6 (Aug. 21, 1960).
ussian.

A theoretical estimate is obtained for the rate of growth from tion, assuming the existence of steps on the growing crystal of a boundary layer in the solution near the crystal. An ogous result is obtained for crystallization from the melt, wing for latent heat and thermal conduction effects. The ence of impurities is briefly considered. R.F.S.Hearmon

539.2 : 548.5

1159

GROWTH POISONING OF LITHIUM FLUORIDE FROM AQUEOUS SOLUTIONS.

G.W.Sears.

hem. Phys., Vol. 33, No. 4, 1068-74 (Oct., 1960).

The presence of a few p.p.m. of step poisons strongly alters crystal growth and dissolution rates. It was known that a few m. ferric fluoride was a poison for the dissolution of lithium ride. In the present report it is shown that ferric fluoride is also owth poison for lithium fluoride from aqueous solution. Ferric ride has the properties characterizing a step poison for the ium fluoride–water system.

539.2 : 548.5

21160

ON THE CRYSTAL GROWTH OF CADMIUM SULPHIDE.

S.Ibuki.

Phys. Soc. Japan, Vol. 14, No. 9, 1181-95 (Sept., 1959).

The crystal growth of CdS was investigated in detail, mainly by method of sublimation and recrystallization in a flow of nitrogen , with special reference to the growth process and the forms of wn crystals. The conditions were sought under which various ds of crystal forms (needle, lamina, plate, rod, block, twin and isker) are grown. The degree of vaporization in the sublimating ion, the temperature and saturated vapour pressure in the growing ion, the thermal decompostion, the origins of the growth and the ect of dislocation upon crystal growth were investigated. The ree of perfection and luminescence of grown crystals was also served.

539.2 : 548.5

21161

ON THE GROWTH OF CADMIUM CRYSTALS FROM THE VAPOUR.

P.B.Price.

il. Mag. (Eighth Ser.), Vol. 5, 473-84 (May, 1960).

Crystals of cadmium were grown from the vapour on a quartz re in an argon diffusion cell designed so that the temperature, could be measured and the supersaturation, σ, calculated at ery point. A critical σ of ~ 0.4 for nucleation was observed low which no crystals grew and above which the density of ystals increased with σ. For $\sigma <\sim 2$, crystals grew as whiskers d thin platelets independently of σ and T; for $2 <\sim \sigma <\sim 10^2$ the d products were thick hexagonal plates; for $\sigma >\sim 10^2$ and T <~ 0°C spike and leaf dendrites appeared and grew to large dimen- ons. The observed dependence of whisker growth rates on σ and hisker radius showed that growth was probably controlled by the ffusion of cadmium vapour through argon. Evidence for both tip owth and non-tip growth of whiskers is presented.

539.2 : 548.5 : 539.219

21162

A STUDY OF THE KINETICS OF CRYSTALLIZATION OF COPPER FROM LIQUID BISMUTH SOLUTIONS.

.H.Kerridge.

.Inst. Metals, Vol. 88, Pt 2, 74-80 (Oct., 1959).

The rates of crystallization of copper from supersaturated solu- on in liquid bismuth were studied over a range of crystallization mperatures and degrees of supersaturation. The rates can be tted to an equation of the form predicted by the dislocation theory crystal growth. Growth occurred on the nuclei present in the solu- on and not on the copper surfaces in contact with the supersaturated olution. Homogeneous nucleation did not take place until the super- aturation exceeded 450%.

539.2 : 548.5

21163

MODIFICATION IN TECHNIQUE FOR GROWING SINGLE CRYSTALS OF ZnF_2:Mn.

L.M Matarrese and F.L.Hughes.

appl. Phys., Vol. 31, No. 11, 2063 (Nov., 1960).

Crystals of good optical quality were grown by the Stockbarger rocess using a crucible with a shaped graphite insert.
D.G.Holloway

539.2 : 548.5

21164

SOLVENT EVAPORATION TECHNIQUE FOR THE GROWTH OF ARSENIC-DOPED GERMANIUM SINGLE CRYSTALS FOR ESAKI DIODES.

F.A.Trumbore and E.M.Porbansky.

J. appl. Phys., Vol. 31, No. 11, 2068 (Nov., 1960).

The method uses a normal pulling apparatus. The seed crystal is dipped into an arsenic-doped melt and rotated, but not pulled. As As evaporates from the melt, As-doped Ge is precipitated or grown on the seed crystal. C.A.Hogarth

539.2 : 548.5

21165

SYNTHESIS OF LARGE CdS AND ZnS CRYSTALS.

J.Nishimura and Y.Tanabe.

J. Phys. Soc. Japan, Vol. 14, No. 6, 850-1 (June, 1959).

Large single crystals were synthesized in a reproducible manner from the sulphide powder. By sublimation and condensation a bundle of needle-like grains of similar crystallographic axis is formed. A further heat treatment under saturated vapour allows grain growth to occur which leads to the formation of large single crystals.
W.Bardsley

539.2 : 548.5 : 621.382

21166

THE PRODUCTION OF HIGH-QUALITY GERMANIUM SINGLE CRYSTALS.

I.G.Cressell and J.A.Powell.

Progress in semiconductors, Vol. 2 (London: Heywood. 1957) p. 137-64.

Surveys the available methods (to mid-1956) of crystal growth, and discusses in particular the horizontal zone melt technique as applied to the production of germanium single crystals, ranging in resistivity from intrinsic to that normally used for transistors. As an introduction to the problems of single crystal growth, a brief summary is given of the types of imperfection which may enter the crystal during growth and the effect of these upon the electrical properties. The paper is illustrated by 16 microphotographs showing etch-pit distributions on germanium crystal faces, and the effect of various types of imperfection. The bibliography of 65 references is chosen to be representative rather than exhaustive. J.B.Birks

539.2 : 548.5

21167

PYROLYTIC COATING OF QUARTZ AND CERAMIC VESSELS USED FOR ZONE MELTING.

R.Beels and W.De Sutter.

J. sci. Instrum., Vol. 37, No. 10, 397 (Oct., 1960).

Describes an experimental method using toluene carried in nitrogen and the vessel at 1050°C. The coating has a satisfactory purity and mechanical strength. W.Bardsley

539.2 : 548.5

21168

SURFACE GROWTHS AND WHISKERS ON AN ALUMINIUM–MAGNESIUM ALLOY.

P.J.E.Forsyth, P.G.Partridge and D.A.Ryder.

Phil. Mag. (Eighth Ser.), Vol. 4, 447-50 (April, 1959).

Growths of a crystalline form were obtained at grain boundaries on an Al–7% Mg alloy heated in vacuo between the eutectic (450°C) and solidus (520°C) temperatures. Above the solidus temperature profuse growth occurred over the whole surface of pure Al poly-crystalline whiskers. Growth is associated with grain boundaries along which rapid diffusion occurs, the process involves exudation and extrusion through perforations in a surface film. J.Franks

539.2 : 548.5

21169

TWINNING IN CADMIUM DENDRITES.

P.B.Price.

Phil. Mag. (Eighth Ser.), Vol. 4, 1229-41 (Nov., 1959).

Growth twins of cadmium with a $[12\bar{3}0]$ twin axis and a (0001) composition plane are formed during deposition from the vapour at high supersaturation. The twin crystals grow in the form of flat "leaf" dendrites several millimetres in length and only a few microns in thickness, while other crystals in the deposit are three-dimensional, non-dendritic, and limited in size to a few microns. The experimental conditions under which leaf dendrites appear are given, the morphology of the dendrites and the arrangement of atoms near the composition plane are described, and a connection between twinning and the dendritic growth of cadmium is proposed.

539.2 : 548.5

21170

MICROTWINNING IN EPITAXIAL NICKEL–IRON FILMS.

R.D.Burbank and R.D.Heidenreich.

Phil. Mag. (Eighth Ser.), Vol. 5, 373-82 (April, 1960).

Thin films of permalloy (81% Ni, 19% Fe) grown by evaporation on rock salt cleavage faces were studied in the electron microscope. Selected area diffraction patterns indicate the presence of microtwinning on all types of {111} planes. The diffraction patterns are also subject to the effects of multiple diffraction, film deformation, and an "effective aperture" in the optical behaviour of the electron microscope when used for selected area diffraction. Electron micrographs reveal a "film" that consists of discrete particles, three-dimensional in character, with irregular shapes suggestive of hemispheres of various sizes which have coalesced, side by side. The irregular shapes fit together like pieces of a jig-saw puzzle to cover the film area. Twinned components can be identified with dark field illumination. The three-dimensional particles seem to be a consequence of isotropic growth of crystal nuclei that are in epitaxial orientation but distributed at random over the substrate surface. Microtwinning appears to be a relief mechanism for reduction of the strain energies which accumulate at the boundaries between growing crystal nuclei.

539.2 : 548.5

21171 SURFACE IMPERFECTION AND EPITAXY. P.Vermout and W.Dekeyser.

Physica, Vol. 25, No. 1, 53-4 (Jan., 1959).

An Ag layer deposited on a carbon replica of a rocksalt single crystal surface showed a preferential orientation. It is concluded that imperfections of the substrate surface may have an effect on epitaxy. J.Franks

539.2 : 548.5

21172 ETCHING DAMAGE OF SEMICONDUCTORS BY ION BOMBARDMENT. I.G.Sirotenko and G.V.Spivak.

Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 6, 679-84 (1960). In Russian.

"Cathode Electronics Conference" Moscow, 1959 (see Abstr. 17022 of 1960). The formation of oriented hillocks and etch pits due to bombardment by krypton ions of 1-1.5 kV, and current density 3-12 mA/cm^2 was studied in Ge, Si, and manganese ferrites. Photomicrographs are shown for the (100), (110) and (111) planes of Ge, the (111) plane of Si, and manganese ferrite. Part of the Si surface was shattered at high current densities. It was concluded that the formation of hillocks is due either to the condensing of the crystal vapour or to the capture of flying atoms by surface projections; the symmetry of the etch pits is determined by the various packing densities in various crystal directions. D.J.Huntley

539.2 : 548.5

21173 ETCHING OF STRAINED ALUMINIUM. G.A.Bassett and C.Edeleanu.

Phil. Mag. (Eighth Ser.), Vol. 5, 709-16 (July, 1960).

The initiation of etch attack of strained aluminium was studied by optical and electron microscopy. It is concluded that an important factor is rupture of the protective natural oxide film and its subsequent failure to repair completely in a short time. Slip, in a direction closely parallel to the specimen surface, or a deformation in compression appears to damage the oxide film more severely than deformation in tension. No correlation between etch pits and the end of dislocation lines has been found.

539.2 : 548.5

21174 ORIENTATION-DEPENDENT DISSOLUTION OF GERMANIUM. F.C.Frank and M.B.Ives.

J. appl. Phys., Vol. 31, No. 11, 1996-9 (Nov., 1960).

The dissolution of single crystals of undoped germanium in Superoxol etchant is shown to be very closely completely orientation-dependent by the applicability of recent theorems on crystal dissolution shapes. The results of the theory are outlined, and the method of application is described in detail.

539.2 : 548.5

21175 OBSERVATIONS OF THE DECOMPOSITION OF CRYSTALS OF LEAD IODIDE IN THE ELECTRON MICROSCOPE. A.J.Forty.

Phil. Mag. (Eighth Ser.), Vol. 5, 787-97 (Aug., 1960).

Thin crystals of lead iodide grown from solution were examined in transmission in the electron microscope. The crystals are sufficiently stable in the electron beam to allow dislocations to be observed, but it is found that after prolonged periods of observation at high beam intensities decomposition commences, and proceeds through a number of stages to completion. The initial and intermediate stages are accompanied by the climb of pre-existing dislocations, the formation of new dislocations and the creation of other features which might be interpreted as cavities in the crystal. These can be understood to some extent as a result of the formation of vacancies in the crystal under irradiation with the electron beam the final stage the crystals appear to decompose completely leav an aggregate of dense crystallites which are probably metallic le This is presumably accompanied by the relaease of iodine gas. mechanism for this final stage of decomposition is not yet unders

539.2 : 54

21176 ON KUSNEZOW'S "MUTUAL POLISHING PROCEDU I.Tarján and G.Turchányi.

Acta phys. Hungar., Vol. 8. No. 1-2, 261-8 (1957). In German.

Describes the application of the procedure to NaCl. It is cla that the behaviour differs somewhat from that to be expected fro Kusnezow's simple assumptions. See Abstr. 1199, 6277 of 1953; V.D. Kuznetsov [Kusnezow]: Surface energy of solid bodies. Moscow (1954). J.W.Le

539.2 : 54

21177 ON THE CONTROL OF OPTIMUM CONDITIONS OF ELECTROLYTIC POLISHING OF SEMICONDUCTORS

I.Epelboin and M.Froment.

J. Phys. Radium, Vol. 18, No. 3, 60A-61A (March, 1957). In Fre

Optimum conditions for the electrolytic polishing of germani are given. C.D.

539.2 : 54

21178 ALGEBRAIC METHOD TO OBTAIN IRREDUCIBLE REPRESTATIONS OF SPACE GROUPS WITH AN APPLICATION TO WHITE TIN. S.Mase.

J. Phys. Soc. Japan, Vol. 14, No. 11, 1538-50 (Nov., 1959).

An example is made of white tin having screw axes and glide planes in the symmetry operations. In the present method it is enough to treat explicitly at most only symmetry elements equal number to the operations of the point group to which the lattice concerned belongs, regardless of the cases with or without spin, interior points, or the points of the Brillouin zone boundary. Thi becomes very simplified compared to the usual group-theoretical method.

539.2 : 54

21179 TRANSITION FROM DYNAMICAL TO KINEMATICAL INTENSITIES OF ELECTRON DIFFRACTION BY CRYSTALS. S.Miyake.

J. Phys. Soc. Japan, Vol. 14, No. 10, 1347-52 (Oct., 1959).

The transition from dynamical to kinematical intensities wit the change of wavelength of the electrons and crystal thickness is discussed theoretically. It is pointed out that the usual treatment the dynamical theory by the two-wave approximation fails to appl in the case of very short wavelength and small crystal thickness, even with the correction of the dynamical Fourier potential, so th the advent of some convenient treatment taking account of many reflected waves is essential for consideration of the transition of reflected intensities. It is further pointed out, that the applicatio the pseudo-kinematical theory using the complex atomic scatteri amplitude calculated on isolated atoms is not permissible in the case of electron diffraction by crystals even for their thinnest li

539.2 : 54

21180 CONTROLLED ATMOSPHERE SAMPLE CHAMBER F THE NORELCO DIFFRACTOMETER.

H.G.Norment and P.I.Henderson.

Rev. sci. Instrum., Vol. 31, No. 10, 1153 (Oct., 1960).

539.2 : 548

21181 AN OSCILLATING FLAT-SPECIMEN HOLDER FOR X-RAY POWDER DIFFRACTION CAMERA.

J.D.Wilkinson and L.D.Calvert.

J. sci. Instrum. Vol. 37, No. 10, 399-400 (Oct., 1960).

An oscillating flat-specimen holder is described for use with 114.6 mm diameter Norelco X-ray camera, but capable of adapta to any other size or make of powder-diffraction camera. The holder is a stainless-steel half-cylinder, the flat specimen being retained by elastic bands against its flat face. The angle that the specimen face makes with the incident X-ray beam is set externa and is indicated by a pointer. Specimen oscillation of 10° or 20° (not constant angular velocity unless specially designed) is derive from the existing specimen rotation drive. The holder is readily interchangeable with the normal specimen holder, and films take by both methods are directly comparable. R.V.Coa

539.2 : 548.7

182

THE LATTICE CONSTANTS OF SMALL CRYSTALS.

T.B.Rymer.

Cimento Suppl., Vol. 6, No. 1, 294-305 (1957).
arious attempts to detect a change of lattice constant with cry-
size are described. Possible sources of error in electron-
ction measurements are listed, and methods of distinguishing
en strain broadening and small-particle broadening are
dered; it is suggested that a Gaussian line profile indicates
ly strain broadening. Measurements on LiF films show that
is a negative surface tension effect. A.R.Stokes

539.2 : 548.7

1183

NATURE OF THE MOSAIC STRUCTURE OF Ge AND Si MONOCRYSTALS.

Bogorodskii, Ya.S.Umanskii and S.Sh.Shil'shtein.
Akad. Nauk SSSR, Vol. 134, No. 1, 114-16 (Sept. 1, 1960). In
ian.
Monocrystals of Ge (dislocation density 10^2 - 10^6 cm^{-2}) and of
0^2 - 10^3 cm^{-2}) were examined by the method of two-crystal spec-
eter with parallel crystals, the specimens being rotated by
s of the order of 1" with an accuracy of 0.5"; the experimental
r (of the width of the double-reflection curve) is 5" or nearly
alue obtained for ideal Si crystals, so experiments were mostly
ied out with Ge for which the figure is 20". The Ge specimens
a disordered arrangement of dislocations, and at all dislocation
ities the mosaic structure was present, the disorientation and
of aggregates varying but little. F.Lachman

539.2 : 548.7

1184

ACCURATE DETERMINATION OF THE LATTICE PARAMETERS OF BERYLLIUM.

D.R.Schwarzenberger.

Mag. (Eighth Ser.), Vol. 4, 1242-6 (Nov., 1959).
The lattice parameters of a single crystal of beryllium were deter-
ed from observations on a divergent-beam transmission X-ray
ograph of the crystal. Diffraction in the crystal leads to a pattern
eficiency lines on a photographic plate, the geometry of which is
rmined by the lattice parameters of the crystal, and the wave-
th of the radiation, but is independent of the exact experimental
ngement. The values obtained are a = 2.2866 ± 0.0006 A,
3.5833 ± 0.0009 A, c/a = 1.5671.

539.2 : 548.7

1185

GRAPHITIZATION OF DIAMOND.

M.Seal.

ure (London), Vol. 185, 522-3 (Feb. 20, 1960).
A revision of interpretation is proposed concerning some pre-
sly published experimental data relative to the graphitization
erved in diamond at temperatures in the range 1000-2000°C.
raction spots formerly attributed to an intermediate phase of
bon are shown now to have been due to the presence of 1% silicon
urity in the diamonds. The earlier hypothesis of an intermediate
bon structure is therefore now abandoned, the extra spots being
sumed due to silicon carbide impurity and not to diamond.
S.Tolansky

539.2 : 548.7

21186

INFLUENCE OF DISLOCATIONS ON THE INTEGRATED INTENSITIES OF X-RAY REFLECTIONS BY RMANIUM CRYSTALS.

F.Lefèvre and A.Authier.

Phys. Radium, Vol. 20, No. 7, 691-3 (July, 1959). In French.
Dislocations have been introduced in a monocrystal of german-
by successive compressions and the absolute integrated inten-
es of the Bragg reflections of X-rays on this crystal have been
npared for different densities of dislocations.

539.2 : 548.7

21187

DIFFRACTION OF X-RAYS BY POLYCRYSTALLINE SAMPLES OF HYDROGEN ISOTOPES

.Kogan, B.G.Lazarev and R.F.Bulatova.
eksper. teor. Fiz., Vol. 37, No. 3(9), 678-83 (Sept., 1959).
Russian. English translation in: Soviet Physics—JETP (New
rk), Vol. 37(10), No. 3, 485-8 (March, 1960).
Comparison of the interference patterns indicates the existence
isotopic polymorphism. The structural difference between hydro-
and deuterium and the structural proximity of the latter to
tium evidence that the polymorphism is connected, not with a dis-
nilarity of energy spectra, but with a difference of atomic weights.
e observed structural differences of the hydrogen isotopes are in
cord with the hydrogen—deuterium state diagram (Abstr. 5259 of
1959). The parametric data cited as characterizing the structures of these isotopes (tritium and deuterium have a tetragonal lattice with c/a = 1.73 and a = 3.3 and 3.35 A, respectively; hydrogen has either a hexagonal lattice with c/a = 1.73 and a = 3.7 A or a tetragonal lattice with c/a = 0.82 and a = 4.5 A), although in accord with density data and with the results of X-ray investigations of isotope mixtures, still need to be improved in precision by method permitting the production of more complete interference patterns

539.2 : 548.7

21188

THE CHANGE OF VOLUME PRODUCED BY MARTENSITIC TRANSFORMATION IN LITHIUM AND SODIUM.

Z.S.Basinski and L.Verdini.

Phil. Mag. (Eighth Ser.), Vol. 4, 1311-15 (Dec., 1959).

The volume change produced by the martensitic transformation in lithium and sodium was measured. The h.c.p. phase has in lithium a smaller volume, and in sodium a larger volume, than the cubic phase. The values are $\Delta V/V \cong -7 \times 10^{-4}$ and $\Delta V/V \cong +3 \times 10^{-3}$ for lithium and sodium, respectively.

539.2 : 548.7

21189

ACCURATE DETERMINATION OF HYDROGEN POSITIONS IN NH_4Cl BY ELECTRON DIFFRACTION.

S.Kuwabara.

J. Phys. Soc. Japan, Vol. 14, No. 9, 1205-16 (Sept., 1959).

The hydrogen position in NH_4Cl was determined by difference Fourier syntheses of the electron-diffraction Debye—Scherrer ring intensity data at room temperature and at −40°C. The primary extinction effect for strong reflections, such as from the (110) plane, was corrected from the variation of their intensities by changing the accelerating voltages between 20 and 60 kV. By the use of the least squares method, the temperature factors were determined from higher order reflections, whose atomic scattering factors are not affected by ionization. The difference Fourier syntheses showed the coordinate (xxx) of the hydrogen atoms to be x = 0.153 for both the room temperature and the low temperature phases, when the atomic scattering factors for ionized atoms $N^{-0.45}$, $Cl^{-0.81}$ and $H^{+0.315}$ were taken. Only the room temperature phase showed the rotatory vibration of the hydrogen atoms. The results of this experiment are compared with those of X-ray, neutron and other electron diffraction data.

539.2.: 548.7

21190

X-RAY STUDY ON MOLECULAR ROTATION IN TETRAGONAL AMMONIUM NITRATE.

Y.Shinnaka.

J. Phys. Soc. Japan, Vol. 14, No. 12, 1707-16 (Dec., 1959).

Hindered rotation of the nitrate groups was studied by using X-ray diffuse scattering. The first, second, third and fourth order diffuse scatterings of plate-like shape perpendicular to the C*-direction in the reciprocal lattice were observed. These diffuse scatterings were analysed referring to the crystal structure as determined previously by using Laue—Bragg scattering. It was found that the correlation among rotating nitrate groups is strong in the C-direction while it is weak in the direction perpendicular to it and its type is different from that to be expected from the lower temperature modification.

539.2 : 548.7 : 539.16

21191

THE USE OF THE RADIOACTIVE INDICATORS IN THE STUDY OF THE BERYL CRYSTAL LATTICE.

S.Ristić and R.Drašković.

Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 9, 123-31 (March, 1959).

In this work the method of radioactive indicators was used to study the incorporation of various ions in the crystal lattice of beryl. The use of radionuclides Co^{60} and Cs^{137} was made in order to prove some earlier anticipations on the substitution and incorporation reactions of the beryl crystal lattice, as well as to contribute to the explanation of some other physicochemical properties of this lattice.

539.2 : 548.7

21192

THE X-RAY INVESTIGATION OF THE DECOMPOSITION OF SUPERSATURATED SOLID SOLUTIONS OF SMALL SOLUBILITY.

A.M.Elistratov and P.R.Kamadzhiev.

Dokl. Akad. Nauk SSSR, Vol. 125, No. 3, 538-41 (March 21, 1959).
In Russian.

The decomposition of supersaturated solid solutions of copper in germanium has been investigated by examining the anomalous scattering and double diffraction of X-rays in the solution. It is considered that during decomposition a specific structure change occurs and associated with it the phenomena of double diffraction. The latter is thought to occur as the result of the scattering of X-rays from dislocations which form the nucleus of a precipitating phase (probably Cu_3Ge). The structure of the scattering regions is not understood, but the dimensions are estimated to be $l > 1000$ A, $d \leq 100$ A. In spite of the small concentrations of Cu in the solutions the structure changes are sufficient to allow observation of the double diffraction effects. The general character of the structure changes is in agreement with the deformation phenomenon worked out for the decay of the solid solution CuBe (Elistratov 1955) in spite of the big difference in concentrations. K.N.R.Taylor

539.2 : 548.7

21193

DISTRIBUTION OF ELECTRONS IN CADMIUM SULFIDE CRYSTALS.

G.P.Mohanty and L.V.Azároff.

Phys. Rev., Vol. 120, No. 4, 1224-5 (Nov. 15, 1960).

Very accurate X-ray diffraction intensities from a "pure" CdS crystal and one doped with chlorine were used to calculate electron density maps of their crystal structures projected along the c-axis. To eliminate series termination errors, a difference map obtained by subtracting the electron density of the "pure" crystal from that of the doped crystal was also prepared. According to this map, the electron distribution in the doped crystal is smeared out in the vicinity of the atom centres and an excess of electrons occurs in interstitial sites. This is contrary to the findings of Shuvalov (Abstr. 1737-8 of 1957) who observed the formation of "electron bridges" along lines joining adjacent atoms. It is concluded that the present observations are consistent with a partial disorder introduced in the doped crystal by the substitution of chlorine into sites normally occupied by sulphur atoms. Observed variations between corresponding X-ray intensities of the doped and undoped crystal can be similarly explained by changes in the extinction effect due to this disorder.

539.2 : 548.7

21194

ELECTRON-DIFFRACTION INVESTIGATION OF THE PRODUCTS OF OXIDATION OF PbS.

T.M.Zimkina and V.N.Shchemelev.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1643-9 (July, 1960). In Russian.

When oxidized at 400-550° C, thin mono- and polycrystalline PbS films are found to contain the compound $4PbO{\cdot}PbSO_4$, characterized by a tetragonal lattice with parameters a = 11.60 and c = 7.30 A; the same chemical compound has perhaps also another modification, characterized by orthorhombic lattice with parameters a = 11.70, b = 11.50 and c = 7.30 A. See also Zimkina, Zh. tekh. Fiz., Vol. 28, No. 5, 999 (1958). F.Lachman

539.2 : 548.7

21195

LATTICE SPACING RELATIONSHIPS IN MAGNESIUM SOLID SOLUTIONS.

D.Hardie and R.N.Parkins.

Phil. Mag. (Eighth Ser.), Vol. 4, 815-25 (July, 1959).

Accurate measurements were made of the lattice spacings in binary magnesium solid solutions containing aluminium, bismuth, cadmium, indium, lead, lithium, silver, tin and zinc. The results show that the lattice distortion accompanying the introduction of a solute depends on the difference in size of the solute and solvent atoms, their relative electronegativity and, where the valency of the solute differs from that of magnesium, the electron:atom ratio in the solution. Where the solute is not divalent, variation of the number of electrons in the conduction band seems to be entirely assciated with the c-dimension of the lattice, in such a way that a regular increase in axial ratio takes place as the electron concentration increases. The manner in which this affects the accepted picture of the distribution of electrons in the Brillouin zones of magnesium is discussed.

539.2 : 548.7

21196

X-RAY STUDIES OF THERMAL CYCLES IN THE TRANSFORMATION OF POTASSIUM CYANIDE.

A.Cimino, G.S.Parry and A.R.Ubbelohde.

Proc. Roy. Soc. A, Vol. 252, 445-56 (Oct. 27, 1959).

Single crystals of pure potassium cyanide, and of potassium cyanide containing various amounts of sodium cyanide in solid solution, have been subjected to cyclic temperature changes traversing the thermal transformation at around −110°C. By means of Laue and Bragg photographs, persistence of the crystal axes has been observed in a "normal cycle" high → low → high, but a metastable crystal form was also produced by a particular sequence of changes. There was considerable hysteresis in the transformation of single crystals. Introducing lattice disturbances by incorporating sodium cyanide in solid solution broadened the transformation. Co-existence was observed of various domains of the low-temperature form in "hybrid" single crystals; there was also evidence for the co-existence of domains of the low- and high-temperature forms over a range of temperatures. These results are discussed in relation to theorie of continuous thermodynamic transformations in solids.

539.2 : 54

21197

THE CRYSTAL STRUCTURE OF SODIUM TRICHLOR MERCURATE(II) DIHYDRATE.

S.S.Malčić.

Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 9, 115-22 (March, 1959). In German.

The rhombic cell of $NaHgCl_3 \cdot 2H_2O$, contains four formula u has space group D_{2h}^{16}—Pnma, with parameters a = 9.372, b = 4.03 and c = 18.71 A. The atomic positions were found approximately from a Patterson projection in the xz plane. The final values of t parameters were determined from repeated Fourier syntheses.

539.2 : 54

21198

β-FERRIC OXYHYDROXIDE AND GREEN RUST.

D.R.Dasgupta and A.L.Mackay.

J. Phys. Soc. Japan, Vol. 14, No. 7, 932-5 (July, 1959).

Evidence that the existence of crystalline $Fe(OH)_3$ has not bee demonstrated by Abe (Abstr. 4719 of 1952) is presented and doubt cast on the existence of β-FeOOH are dispelled. The green rust observed by Yoshioka (1948) is shown to be identical with that foun by Keller (1948) and outline structures are suggested for these co pounds.

539.2 : 548

21199

ON THE STRUCTURES OF THE GLASSY CHALCOGENIDES OF ARSENIC.

A.A.Vaipolin and E.A.Porai-Koshits.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1656-65 (July, 1960). In Russia

An X-ray study has been made of the glassy sulphides, selenides and tellurides of arsenic and of certain three component co pounds. Regularity in the change of structure with composition ha been disclosed. On increasing the atomic number of the group 6 element entering into the composition of the glass and on increasing the number of heavier atoms the distribution of the atoms becomes more compact and symmetrical. After examining the different variants of the structure it was found that the best agreement with the radial density distribution curves for As_2S_3 is found for closely packed chains, bands or layers of minimum thickness. A three-dimensional structure fitted the remaining compounds be A.L.Macka

539.2 : 548.

21200

NEUTRON DIFFRACTION STUDY OF ANTIFERROMAGNETIC $MnTiO_3$ AND $NiTiO_3$.

G.Shirane, S.J.Pickart and Y.Ishikawa.

J. Phys. Soc. Japan, Vol. 14, No. 10, 1352-60 (Oct., 1959).

$MnTiO_3$ and $NiTiO_3$ have a rhombohedral crystal structure sim to $FeTiO_3$, in which layers of Fe and Ti atoms alternate along the rhombohedral axis with oxygen layers between them. A powder neutron diffraction study shows that $MnTiO_3$ has a magnetic structu with the Mn^{2+} spins antiparallel within each layer. On the other ha $NiTiO_3$ has the same magnetic structure as $FeTiO_3$, in which the sp are parallel within each layer and adjacent layers are antiparallel. The spins are directed along the [111] direction in $MnTiO_3$ and perpendicular to it in $NiTiO_3$. In addition to the magnetic study, the nuclear intensities indicate that the Ni and Ti in $NiTiO_3$ are only 88% ordered.

539.2 : 548

21201

STRUCTURE OF POTASSIUM HYDROXIDE: AN X-RA AND INFRARED STUDY.

J.A.Ibers, J.Kumamoto and R.G.Snyder.

J. chem. Phys., Vol. 33, No. 4, 1164-70 (Oct., 1960).

Infrared evidence has been obtained which indicates that the crystal structure of KOH reported in the literature is incorrect. A subsequent X-ray examination has shown that this is the case an has led to a structure compatible with the infrared spectrum. KO crystallizes in the monoclinic space group C_2^2—$P2_1$ (chosen over $P2_1/m$ on the basis of the infrared evidence), with two molecules i a cell of dimensions a = 3.95, b = 4.00, c = 5.73 A, β = 103.6°. Eac potassium atom is surrounded by a distorted octahedron of oxygen atoms. There is an oxygen—oxygen zigzag chain parallel to the b axis. Stereochemical arguments are advanced to suggest that the hydrogen atoms are near to or lie in the plane of the zigzag oxyge chain; infrared data obtained at −180° C for KOH and KOD are inte preted as supporting the placement of the hydrogen atoms in order ons along the chain with the O–H · · ·O bonds (of length 3.35 A) y or exactly linear. It is argued that breaking of these hydrogen will lead to the high-temperature cubic structure of KOH ted in the literature.

539.2 : 548.7

202 A STRUCTURAL STUDY OF THE COMPOUND AgSbTe$_2$. R.W.Armstrong, J.W.Faust, Jr and W.A.Tiller.

l. Phys., Vol. 31, No. 11, 1954-9 (Nov., 1960).

-ray, optical and electron microscope, and chemical etching ques have been used to investigate a striated microstructure ved in zone refined single crystals of the AgSbTe$_2$ structure. microstructure, originally thought to be fine twin lamellas, een identified as a Widmanstatten precipitate of Sb$_2$Te$_3$ upon 11} planes of the matrix face-centred cubic material. In on, the evidence obtained from all the measurements made on aterial indicates that the ternary compound of the AgSbTe$_2$ loes not melt congruently.

539.2 : 548.7

203 CRYSTAL STRUCTURE OF 2-AMINO AZULENE. Y.Takaki, Y.Sasada and I.Nitta.

ys. Soc. Japan, Vol. 14, No. 6, 771-6 (June, 1959).

A systematization is proposed for the determination of the al structure when the crystal consists of molecules of known The refinements of structure are separated at an early by the method of least squares into (1) successive improve- s of the position and orientation of the molecules and (2) correction molecular shape fixing the molecular position and orienta- The result of the application of this method to the crystal of ino azulene ($a = 11.62$, $b = 10.76$, $c = 6.32$ A, $Z = 4$, space Pbn2$_1$) is given.

539.2 : 548.7

1204 ON THE CRYSTAL STRUCTURE OF METHANOL AT –180°C. G.S.R.Krishna Murti.

n J. Phys., Vol. 33, No. 10, 458-60 (Oct., 1959).

The Debye–Scherrer X-ray pattern is obtained for a crystal at °C and the structure found to be still monoclinic as at –160°.

G.F.J.Garlick

539.2 : 548.7

205 HOLLOW PYRAMIDAL CRYSTALS OF POLYETHYLENE AND A MECHANISM OF GROWTH.

Niegisch and P.R.Swan.

l. Phys., Vol. 31, No. 11, 1906-10 (Nov., 1960).

A hollow pyramidal model for diamond-shaped single crystals yethylene is proposed which accounts for the electron micro- observations and electron diffraction effects presented in this and in the literature. The pyramidal shape occurs because ows of folded molecules along the (110) growth face in each ant of the crystal are translated along the molecular chain tion by two carbon-carbon distances relative to the previous This translation presumably occurs in order to relieve steric ferences at the folds or loops of the polymer chain. The result- iclinic cell, of which the familiar orthorhombic cell is in ty a subcell, has a c dimension equal to the constant fold length e polymer chain, and remaining parameters of $a = 7.84$ A, .56 A, $\alpha = (90-27.3)^\circ$, $\beta = (90-19.0)^\circ$ and $\gamma = 81.5^\circ$. The values and 27.3° are, respectively, arctan (c/a) and arctan (c/b) of the rhombic subcell, so that the (001) planes of the triclinic cell h contain the folds on the surface of the pyramids are (111) es relative to the orthorhombic subcell.

539.2 : 548.7

1206 ON THE X-RAY DIFFUSE SCATTERING BY 1-3-5-TRIPHENYLBENZENE. M.S.Farag.

Phys. Soc. Japan, Vol. 14, No. 6, 755-8 (June, 1959).

In crystalline 1-3-5-triphenylbenzene every four molecules n a pseudo-hexagonal orthorhombic unit cell with the [100] as pseudo-hexagonal axis. The deviation from hexagonal symmetry ch is only 0° 19′ is discussed in terms of both the crystal cture and the diffuse scattering reflections shown by a Laue tograph taken with the X-ray beam parallel to the [100] axis. other Laue photographs with the X-ray beam parallel to the 0] and [001] axes are given. All the diffuse scattering reflections he three photographs are indexed and the types of elastic waves thermal origin) affecting the crystal lattice are revealed.

VARIOUS SOLID STRUCTURES

539.21

21207 PRESENTATION OF EVIDENCE OF A STRUCTURE INDICATING MARTENSITIC SHEARING. H.Bibring.

Acta metallurgica, Vol. 7, No. 10, 684-5 (Oct., 1959). In French.

Preliminary results are given of a study of martensitic transformations in Co and Co–25% Ni. R.F.Peart

539.21

21208 EXPERIMENTAL EVIDENCE FOR MARTENSITIC EMBRYOS. M.H.Richman, M.Cohen and H.G.F.Wilsdorf.

Acta metallurgica, Vol. 7, No. 12, 819-20 (Dec., 1959).

Transmission electron microscopy was used to study martensitic transformations in Fe–Ni alloys. Quantitative measurements on lenticular embryos detected in the austentite matrix, gave reasonable agreement with recent theories that require the presence of pre-existing embryos as "frozen-in" during cooling from austenitizing treatment. R.F.Peart

539.21

21209 THE MARTENSITE TRANSFORMATION IN THIN FILMS OF IRON ALLOYS. W.Pitsch.

J. Inst. Metals, Vol. 87, Pt 12, 444-8 (Aug., 1959).

The martensite transformation was investigated in thin films of iron alloys. Under these experimental conditions the martensite consists of very thin fibre crystals which are twin-orientated. The orientation relationship is $[\bar{1}10]_A \parallel [11\bar{1}]_M$ and $(110)_A \parallel (112)_M$. This differs from any orientation relationship found in massive material. The difference is explained by the fact that, in thin films, the transformation mechanism is less hampered by the surrounding parent lattice than it is in massive material. A simple transformation mechanism for thin films is deduced, consisting of a pure distortion and half a twin shear. Extending this mechanism by a rigid rotation of the martensite lattice, another mechanism is developed which describes the transformation with {225} habit in massive material.

539.21

21210 THE MARTENSITE TRANSFORMATION IN THIN FOILS OF IRON–NITROGEN ALLOYS. W.Pitsch.

Phil. Mag. (Eighth Ser.), Vol. 4, 577-84 (May, 1959).

The martensite transformation in thin foils of an iron–nitrogen alloy was investigated. Under these particular experimental conditions the martensite consists of very thin fibre crystals which are twin orientated. The orientation relationship is

$$[1\bar{1}0]_{\gamma} \parallel [111]_{\alpha'}, \text{ and } [001]_{\gamma} \parallel [1\bar{1}0]_{\alpha'}.$$

This is different from all orientation relationships found in bulk materials. The difference is explained by the fact that in thin foils the transformation mechanism is less hampered by the surrounding parent lattice than in bulk materials. A simple transformation mechanism is deduced consisting of a pure distortion and a half twin shear.

539.21

21211 THE IRRADIATION-INDUCED PHASE TRANSFORMATION IN ZIRCONIA SOLID SOLUTIONS.

J.Adam and B. Cox.

Reactor Science, Vol. 11, No. 1, 31-3 (Nov., 1959).

The results of X-ray diffraction studies of the effect of neutron irradiation on the structure of ZrO$_2$ and ZrO$_2$ solid solutions with various additives are reported.

539.21

21212 THE OBSERVATION OF ANTI-PHASE BOUNDARIES DURING THE TRANSITION FROM CuAu I TO CuAu II.

D.W.Pashley and A.E.B.Presland.

J. Inst. Metals, Vol. 87, Pt 12, 419-28 (Aug., 1959).

Thin single-crystal films of Cu–Au alloy were examined by high-resolution electron microscopy, and the domain structure in both the CuAu I and the CuAu II superlattices revealed. The arrangement of the anti-phase domain boundaries is shown to be modified by the presence of dislocations. The specimens were annealed inside the electron microscope, so that the transition from CuAu I to CuAu II was observed in detail. It is found that the transition does not involve any dislocation mechanism. The significance of the results in relation to the mechanical properties of ordered alloys is discussed.

539.211

21213 A SIMPLIFIED TREATMENT OF SURFACE MELTING. W.W.Mullins.
Acta metallurgica, Vol. 7, No. 11, 746-7 (Nov., 1959).

Deals with the "atomic roughening" occurring with rising temperature. A simpler treatment of the mathematical problem is suggested, that may be applied to (1) other crystal planes and structures, (2) the presence of more than one species of atom, (3) a model with more than three geometrical levels of surface atoms. A comparison is made with other methods.
H.E.Schmid

539.211

21214 ON SURFACE ROUGHNESS. K.A.Jackson.
Acta metallurgica, Vol. 7, No. 11, 747-8 (Nov., 1959).

Discusses the degree of equilibrium surface roughness on surface melting a crystal if there is another phase at the crystal surface. There is a difference according to whether or not the two phases are in equilibrium.
W.Bardsley

539.211 : 537.534

EFFECT OF ION BOMBARDMENT ON METAL SURFACES.
See Abstr. 19803

539.213

21215 CHANGES IN THE SURFACE STRUCTURE OF GLASSES PRODUCED BY INTENSE ULTRASONIC WAVES. P.Greguss.
Acustica, Vol. 9, No. 3, 126-8 (1959). In German.

Electron microscope examination revealed some changes in the degree of irregularity of the surface of thermometer glass after treatment by intense unltrasonic waves.
D.M.Schlapp

539.213

21216 THE PROPERTIES OF BINARY PHOSPHATE GLASSES. C.A.Elyard, P.L.Baynton and H.Rawson.
B.T.-H. Res. Lab. Publ., No. 376, 8pp. (1959).

Binary phosphate glasses were prepared containing the oxides of the elements Mg, Ca, Sr, Ba, Pb, Zn, and Cd. The properties which were determined include density, thermal expansion coefficient, viscosity, electrical resistivity, durability, limits of glass formation and devitrification behaviour. The range of compositions covered was limited at high P_2O_5 contents by excessive volatilization of P_2O_5 and at high RO contents by devitrification, but in general the range was from 35 to 55 mol % RO. It was found that in the range studied increasing the RO content increased the rigidity of the glass structure as shown by decreasing thermal expansion coefficient and increasing viscosity. It is suggested that this behaviour cannot be explained satisfactorily by the generally accepted form of the random network theory, and an alternative structural picture is put forward which is believed to be more in accord with the facts.

539.213

21217 SURFACE CRACKS OF SHEET GLASS PRODUCED BY SODIUM VAPOR TREATMENT. J.Nakayama.
J. Phys. Soc. Japan, Vol. 14, No. 8, 1107-13 (Aug., 1959).

Observations were made on the surface cracks of soda-lime-silica sheet glass produced by sodium vapour treatment in vacuum at 350°C. It was suggested first by Andrade and Tsien (1937), and recently concluded by Gordon et al. (Abstr. 3261 of 1960) that these surface cracks are developed from latent Griffith cracks through some etching action of the sodium vapour. According to the present experiment, several phenomena occur which are difficult to explain by the latent crack theory. The correlations of surface cracks with the drawing marks, or to the direction of the periphery of the specimen, for instance, can be more reasonably explained by the cracking mechanism due to the shrinkage of transmuted surface layers after the sodium vapour attack. Therefore, it would seem that the surface cracks are originated by the treatment.

539.213

21218 STRUCTURE OF FLUORIDE CONTAINING OXIDE GLASS IN RELATION TO THE POSSIBLE RÔLE OF FLUORIDE ION IN THE VITREOUS MATRIX. B.K.Banerjee.
Proc. Nat. Inst. Sci. India A, Vol. 25, No. 3, 155-60 (May, 1959).

The role of the fluoride ion in different oxide glass bases was investigated. The X-ray diffraction by each fluoride sample was critically examined. It was observed that fluoride ions exist in glass in two or more forms, one of which participates in the glass network like an oxygen ion. Other properties of fluoride are also mentioned.

539.213 : 538.27 : 53

21219 LINE SHAPES OF ELECTRON PARAMAGNETIC RESONANCE SIGNALS PRODUCED BY POWDERS, GLASSES, AND VISCOUS LIQUIDS. F.K.Kneubühl.
J. chem. Phys., Vol. 33, No. 4, 1074-8 (Oct., 1960).

The line shapes arising from randomly oriented particles in fixed position are calculated. It is found that it is possible to det mine the three principal g factors with relatively high accuracy without investigating single crystals. Measurements on powders $CuCl_2 \cdot 2H_2O$ and $CuSO_4 \cdot 5H_2O$ are used as examples. In addition, th influence of Brownian rotation in viscous liquids on line shapes ha been studied. Equations are derived for the case of high viscosit supplementing the well-known ones given by McConnell (1956). T first approximation, the effect of decreasing viscosity can be described by an over-all diminishing linewidth and an unchanged line shape function. The hyperfine splittings are neglected, but can be taken into account.

539.

21220 THE FINE STRUCTURE OF FILMS OF [NATURAL] RUBBER AND OTHER POLYMERS. M.Seal.
Phil. Mag. (Eighth. Ser.), Vol. 5, 78-83 (Jan., 1960).

High resolution electron microscopy was used. Dispersions various materials (in particular neoprene and chlorinated natural rubber) in natural rubber were studied. Structures which are believed to be the individual curled-up molecules of the dispersed polymer were photographed. Stretched rubber films were exami and some information about the mode of deformation was obtaine

539.214 : 535.

21221 PHOTOGRAPHIC LIGHT SCATTERING BY POLYETHYLENE FILMS. R.S.Stein and M.B.Rhodes.
J. appl. Phys., Vol. 31, No. 11, 1873-84 (Nov., 1960).

The photographic light scattering technique permits a measurement of the size, anisotropy, radial periodicity, packing, and inter structure of polymer spherulites. The theory of some of these effects is described, and experiments are presented showing chang occurring in the melting and growth of spherulites.

539.2

21222 THE DETERMINATION OF SPECIFIC SURFACES AN INTERFACES BY SMALL-ANGLE SCATTERING OF X-RAYS. II. EXPERIMENTAL STUDIES.
C.Alexanian, S.Durif and J.L.Soulé.
J. Phys. Radium, Vol. 20, Suppl. No. 12, 139a-152a (Dec., 1959). French.

An account is given of the experimental studies carried out t find the best conditions for applying theoretical results (see Pt I, Abstr. 6350 of 1960), in particular, to the determination of specific surfaces. After a survey of the experimental difficulties and of the main sources of error in the absolute measurement of the scattering intensity, it is shown that the conditions of application depend upon the magnitude of the internal structure. For extreme structures, only one method is applicable: an attenuator must be used; for intermediate structures, the use of sufficiently thick samples ensures that the scattered and directly transmitted intensities have the same range of magnitude. Examples are give of the different ranges of structure and a comparison is made of the methods used in the case of intermediate structures.

539.2

21223 PACKING OF MIXTURES OF HARD SPHERES. P.C.Mangelsdorf, Jr and E.L.Washington.
Nature (London), Vol. 187, 930 (Sept. 10, 1960).

Some experimental results are reported on the packing of binary mixtures of "Lucite" spheres. These are compared with other experimental and theoretical work on the packing problem.
H.N.V.Temper

539.2

21224 AN UNUSUAL GRAIN BOUNDARY DIFFUSION EFFE IN IMPURE NICKEL. H.Mykura.
Phil. Mag. (Eighth Ser.), Vol. 4, 907-11 (Aug., 1959).

The formation of ridges at the grain boundaries of nickel dur thermal etching was observed. The effect is attributed to the dif sion of vacancies along the grain boundaries into the specimen, caused by the formation of internal gas bubbles.

539.2

21225 N.M.R. ABSORPTION IN TEFLON FIBERS. D.Hyndman and G.F.Origlio.
J. appl. Phys., Vol. 31, No. 11, 1849-52 (Nov., 1960).

Vuclear magnetic resonance absorption in oriented polytetra-
oethylene fibres has been investigated in the temperature range
-380°K. The sample, in the form of a parallel bundle of fibres,
ed a marked dependence of line shape on the direction of the
ed magnetic field over the temperature range studied, although
bserved anisotropy was much greater above 285°K than below.
ges occurring in the linewidth and second moment at around
K indicate a rotational disorder transition in the crystalline
ons of the polymer, and serve to illustrate the advantages of
oriented fibres in the n.m.r. investigation of semicrystalline
ners.

539.219

1226 ALLOTROPIC TRANSFORMATIONS IN PLUTONIUM.
J.D.Hill.

re (London), Vol. 186, 304-5 (April 23, 1960).

An investigation was carried out into the rates of transformation
een the various modifications of Pu, by a dilation method,using
ısitive transducer system. The temperatures of thermodynamic
ibrium were estimated to be: $\alpha \rightleftharpoons \beta$, 112° ± 1°C; $\beta \rightleftharpoons \gamma$,
± 2°C; $\gamma \rightarrow \delta$, near 310°C. It was considered that the β-phase
rmed more easily from either the α- or γ-phases than these
formed from the β-phase. J.Thewlis

539.219

1227 ON THE ORIENTATION OF SILICON PRECIPITATING FROM AN Al-RICH SOLID SOLUTION.
.Rosenbaum, D.Turnbull and E.I.Alessandrini.

a metallurgica, Vol. 7, No. 10, 678-9 (Oct., 1959).

Silicon precipitated in Al–1% Si allows shows preferred
entation, and forms as platelets parallel to the (100) and (111)
ıes of the Al matrix. Electron microscope studies show that
nuclei are randomly oriented, and that only those nuclei having
appropriate orientation grow rapidly and so form plates.
H.Mykura

539.219

21228 THE EXISTENCE OF SEVERAL STAGES OF PRECIPITATION WITH Ti-HARDENED Cu-ALLOYS.
anenc.

a metallurgica, Vol. 7, No. 12, 807-8 (Dec., 1959). In French.

The precipitation of Cu_3Ti in the binary Cu–Ti was investi-
ed in the range of 1.5-5 wt% Ti. X-ray examinations showed
temperature dependence of the precipitation of two transition
ses until the equilibrium phase Cu_3Ti was reached.
H.E.Schmid

539.219

21229 HEATS OF FORMATION OF LIQUID Na–Cs ALLOYS.
R.A.Oriani.

a metallurgica, Vol. 7, No. 12, 808-9 (Dec., 1959).

Four proportions of liquid Cs and liquid Na were mixed in a
orimeter at 112°C. Results are given in a table to an accuracy
±5. The liquid alkali–metal binary is characterized by positive
halpies of formation, and good agreement with other investi-
ors is confirmed. H.E.Schmid

539.219

21230 THE GROWTH OF PRECIPITATES FROM SOLID SOLUTIONS. J.Burke.
ta metallurgica, Vol. 7, No. 12, 810-11 (Dec., 1959).

A refinement of the model suggested by Zener (Abstr. 3415 of
50) and Wert (Abstr. 3417 of 1950) is presented and is based upon
nodel more closely representing real conditions. R.F.Peart

539.219

21231 THE WHITE TIN → GREY TIN TRANSITION IN TIN–MERCURY ALLOYS. R.W.Smith.
nad. J. Phys., Vol. 38, No. 5, 588-92 (May, 1960).

The effect of the addition of mercury on the linear rate of white
(β) → grey tin (α) transformation in a number of dilute tin–binary
loys has been examined. Rates of transformation at −78° and
25°C are shown for binary alloys of zone-refined tin and aluminium,
senic, bismuth, germanium, indium, lead, antimony, and zinc, and
so for a number of commercially pure tins. The resultant rates of
l of these upon further alloying with 0.6 at.% Hg are likewise given.
−78°C, the addition of mercury always produces a very low trans-
rmation rate, approximately 4×10^{-4} mm/hr. However, at −25°C,
increase in rate is observed in certain cases. The results are
scussed and a theory is developed to account for them and also to
edict the effect of mercury on the $\beta \rightarrow \alpha$ transition in any tin-binary
stem.

539.219

21232 SOLUBILITY OF EXCESS FERRIC OXIDE IN NiZn FERRITES.
V.V.Latsh, N.G.Minaev, B.Kh.Somin and N.É.Stepina.

Fiz. tverdogo Tela, Vol. 2, No. 9, 2191-8 (Sept., 1960). In Russian.

The results of chemical, metallographic, and X-ray analyses of NiZn ferrites (NiO/ZnO = 0.47-4.0), containing 50-95 mol.% Fe_2O_3, showed that on heating in air Fe_2O_3 dissociates to magnetite which forms a continuous series of solid solutions with ferrite. Depending on the relative proportions of ferrite and ferric oxide, the temperature at which the latter becomes fully dissociated varies from 1450°C for pure Fe_2O_3 to 900°C for ferrite with a slight excess of Fe_2O_3. On cooling in air, magnetite dissolved in ferrite becomes fully or partly oxidized to form either γ-Fe_2O_3 which is soluble in ferrite, or α-Fe_2O_3 which is precipitated as a second phase. The formation of a solid solution of γ-Fe_2O_3 in ferrite is possible only by oxidation of dissolved magnetite at low temperatures. M.H.Sloboda

539.219

21233 CONTRIBUTION OF LATTICE VIBRATIONS TO THE ORDER–DISORDER TRANSFORMATION IN ALLOYS.
P.J.Wojtowicz and J.G.Kirkwood.

J. chem. Phys., Vol. 33, No. 5, 1299-1310 (Nov., 1960).

The lattice vibrational partition function for a binary crystal is constructed from the normal mode frequencies in the classical nearest-neighbour harmonic approximation. The set of frequencies is computed as a function of the short-range order parameter by the use of the Born–von Karman analysis and second-order perturbation theory. The resulting form of the lattice vibrational partition function closely resembles that of the static configurational partition function so that a re-examination of the statistical thermodynamics, including lattice vibrational effects, proves to be straightforward. The derived thermodynamic quantities are compared with experiment for the case of β-brass. The theoretical heat capacity discontinuity as calculated by the method of Bethe and Kirkwood is increased from 1.7 R to 6.1 R by the inclusion of the lattice vibrational contribution. The agreement with the experimental value of about 5 R is now satisfactory.

539.219

21234 STUDY OF VACUUM DEPOSITION OF METALS. I. ON THE FORMATION OF ALLOYS BY SUCCESSIVE DEPOSITION OF CONSTITUENT METAL VAPOURS IN VACUUM.
Y.Fujiki.

J. Phys. Soc. Japan, Vol. 14, No. 7, 913-17 (July, 1959).

The formation of alloy phases by successive deposition of constituent metal vapours in a vacuum was investigated by a electron diffraction method for some binary alloy systems. It was concluded that the temperature of the surface layer of primary deposit is raised by the deposition of secondary metal vapour. This temperature rise, which contributes to the formation of alloy phases, is mainly due to the latent heat of condensation of the metal vapour which deposits on the substrate, and consequently metal pairs which have a larger latent heat of condensation may form alloys easier than those which have smaller ones. It was also suggested that some structural defects in the substrate layer would contribute to the formation of alloy phases.

539.219

21235 ANTI PHASE DOMAINS IN GOLD–COPPER–ZINC ORDERED ALLOYS REVEALED BY ELECTRON MICROSCOPE.
S.Ogawa, D.Watanabe, H.Watanabe and T.Komoda.

J. Phys. Soc. Japan, Vol. 14, No. 7, 936-41 (July, 1959).

Using thin evaporated films of gold–copper–zinc ternary ordered alloys, the line-up of antiphase domains was observed as parallel lines on transmission electron micrographs of bright field, down to a domain size of about 8 A. The lattice modulation accompanying antiphase domains, i.e. the periodic error of lattice spacing or scattering factor with the same period as a domain size, was again shown to play an important role in forming the satellites around the direct spot on a diffraction pattern, and hence, in forming the parallel lines on electron microscopic images. Two-thirds of the intensity of the satellites were estimated in the present alloy films to arise from the modulation, and the rest probably from double diffraction.

539.219

21236 A FEW QUARTERNARY SYSTEMS OF PEROVSKITE TYPE A^2+B^4+O_3 SOLID SOLUTIONS. T.Ikeda.
J. Phys. Soc. Japan, Vol. 14, No. 10, 1286-94 (Oct., 1959).

The properties of the quarternary systems (Sr,Pb)(Ti,Zr)O_3

and $(Ba,Pb)(Ti,Sn)O_3$ are studied. The shift of transition points with composition is measured by the temperature variation of the dielectric constant of the ceramic sample, and the phase diagrams at room temperature are determined with help of X-ray measurement. The phase diagram of $(Sr,Pb)(Ti,Zr)O_3$ includes two ferroelectric phases F_α (rhombohedral) and F_β (tetragonal), two antiferroelectric ones A_α (pseudotetragonal) and A_β (tetragonal) and a paraelectric one P. A_β occupies larger area than expected. The diagram of $(Ba,Pb)(Ti,Sn)O_3$ resembles that of $(Ba,Pb)(Ti,Zr)O_3$ and consists of F_1, F_2 (the same as the low temperature phases of $BaTiO_3$), F_α, F_β and P, although the immiscible region is found in the composition containing smaller amounts of Ba and Ti. The graphical classification of perovskite ABO_3 compounds, on the basis of electronic polarizability of A ion radius of B ion, is discussed. Furthermore, the possibilities for dielectric and piezoelectric use of the ceramic materials belonging to these systems are examined. Larger dielectric constants are found with certain compositions in $(Ba,Pb)(Ti,Sn)O_3$, but a striking improvement for PZT ceramics may be rather questionable in both systems.

539.219

21237 A THEORETICAL TREATMENT OF THE EXCESS ENERGIES OF BINARY METALLIC SOLUTIONS.

M.Shimoji.
J. Phys. Soc. Japan, Vol. 14, No. 11, 1525-37 (Nov., 1959).

A simplified theoretical treatment of the excess energy of a binary metallic solution, which is based upon a principle of the cellular approximation, is presented. The average size of the atomic polyhedron of a metallic solution, corresponding to the boundary correction of the metallic state, is determined under the condition of a minimum of the total energy of the system. This calculation contains many factors such as the effects of the lowest energy of the valence electrons, the Fermi energy, the interelectronic energy, the ion-core repulsive energy, the van der Waals energy etc. As the purpose of any theory of metallic solutions is to predict the excess quantities from a knowledge of the properties of the pure components, a semi-empirical expression determined only from the quantities of the pure metals is employed in some parts for the estimation of the above factors quantitatively. The present calculation is free from the classical elasticity theory which has been used in the theories of solid solutions, some difficulties having been pointed out. Furthermore, the energetic asymmetry of most metallic solutions can qualitatively or quantitatively be explained by the present treatment.

539.219

21238 STUDY ON PRECIPITATION PHENOMENA DURING AGING OF ALUMINIUM—SILVER ALLOY IN THIN EVAPORATED FILMS.

Y.Fukano and S.Ogawa.
J. Phys. Soc. Japan, Vol. 14, No. 12, 1671-9 (Dec., 1959).

Precipitation phenomena during ageing were observed on Al—20 wt.% Ag alloy in thin evaporated films by electron microscopy and electron diffraction. A supersaturated solid solution was successfully obtained in thin films by a new quenching method. In a pre-precipitation stage, aggregates composed of random clusters were found in electron micrographs, no appreciable diffraction effect having been perceived. In a true precipitation stage precipitates were found in electron micrographs to change from a needle-like to a three-dimensional shape with increasing ageing, the axial ratio obtained from diffraction patterns changing from 1.63_5 to 1.59 passing 1.61_8. A feature of the present study is that a hexagonal precipitate with the ideal axial ratio was detected in the course of ageing. Except for this point, the results obtained confirm generally those reported by X-ray studies. So-called "equal-thickness interference fringes" were found in images if precipitates aged at 250°C.

539.219

21239 THE EFFECT OF QUENCHING ON THE FORMATION OF G.P. ZONES AND θ' IN Al—Cu ALLOYS.

J.M.Silcock.
Phil. Mag. (Eighth Ser.), Vol. 4, 1187-94 (Oct., 1959).

X-ray methods were used to estimate the quantities of G.P. zones and θ' formed in Al-4%Cu and Al-4%Cu-0.05% In alloys after various heat treatments. The rate of formation of G.P. zones decreases not only on slower quenching but also on lowering the reversion treatment temperature. The addition of a trace of indium (Cd, Sn) is known to decrease the rate of zone formation which is then negligible except after very fast quenching. The rate of formation of the metastable precipitate θ' is dependent on dislocations present in the alloy rather than an excess mobile vacancy concentration, Traces of indium (or cadmium) form even more efficient nuclei for θ' than dislocations but the effect of the indi (or cadmium) is destroyed by fast quenching or cold work. It appears that there is a strong indium-vacancy association whic prevents excess vacancies from accelerating the diffusion rate the copper. When sufficient dislocations are present the indium atoms are trapped and no longer nucleate θ'.

53

21240 FATIGUE DEFORMATION IN THE INTERIOR OF A TERNARY ALUMINIUM—MAGNESIUM—ZINC ALL

I.J.Polmear and I.F.Bainbridge.
Phil. Mag. (Eighth Ser.), Vol. 4, 1293-1304 (Dec., 1959).

Metallographic observations were made of the deformation associated with the fatigue process in the interior of several ag ternary aluminium—zinc—magnesium alloys. It was found that deformation occurring in these relatively complex alloys differs from that observed in pure metals. With alloys which had a hig zinc content the fatigue process was essentially a grain boundar phenomenon and cracking was intercrystalline. As the magnesi zinc ratio was increased deformation occurred within the grains but was concentrated in certain slip bands along which crackin could occur. Cavities were observed in these slip bands and appeared to precede the formation of an actual crack. Zones wh were depleted of precipitate were found adjacent to slip bands in heavily deformed regions and these zones are considered to for by a process of re-solution of the precipitate. As the magnesiu zinc ratio was increased still further the fatigue process was accompanied by little visible evidence of deformation. This stru tural stability is attributed to the relatively high magnesium con tent and these alloys had the best fatigue properties.

539

21241 X-RAY EVIDENCE FOR SEGREGATION OF SOLUTE TO STACKING FAULTS IN A COPPER—ALUMINIUM ALLOY.

R.W.Cahn and R.G.Davies.
Phil. Mag. (Eighth Ser.), Vol. 5, 1119-26 (Nov., 1960).

A study was made of the intensity of scattering of monochro tic X-rays at small angles from a copper-base solid solution con taining 15 at. % aluminium. The intensity of scattering from a r foil was found to increase after heating at 150-250°C, a temperat range in which the alloy hardens, and there is little or no recrys lization. This increase is attributed to segregation of aluminiu the ribbons of stacking fault between partial dislocations. Vario confirmatory tests were performed to check the validity of this conclusion.

539

21242 A MAGNETIC STUDY OF PRECIPITATION IN A GOLD—COBALT ALLOY.

P.Gaunt.
Phil. Mag. (Eighth Ser.), Vol. 5, 1127-45 (Nov., 1960).

The precipitation kinetics of a gold—cobalt (1.5% by weight) were followed by measuring the saturation magnetization of the cipitated cobalt and the results compared with current theories. Marked differences were found between the ageing curves of air water-quenched specimens. The remanent magnetization, coerc force and field to reduce remanence to zero of aged specimens measured and the results were discussed in terms of the single magnetic-domain model. The magnetic properties were compar with those of the gold—nickel system and the conclusion was rea that the dominant contribution to the anisotropy in the gold—coba system was due to particle shape. In an appendix the remanence curve and coercivity for a random array of single-domain ferro netic particles having a linear distribution of anisotropies was c lated and shown to predict the main features of the observed res

539.

21243 THE CHANGES IN VOLUME PRODUCED BY THE MARTENSITIC TRANSFORMATION IN LITHIUM AN SODIUM AT LOW TEMPERATURES.

L.Verdini.
Ricerca sci., Vol. 29, No. 9, 1957-64 (Sept., 1959). In Italian.

The materials tested were Li, a Li-Mg alloy, and Na. The specimen, a circular disk of 15 mm radius and 6-13 mm thick, one plate of a parallel plate condenser comprising part of an ele tronic circuit. The change in thickness of the disk with tempera ture was determined from the change in capacitance of the cond The fractional contractions in volume of Li and the alloy were order of 6×10^{-4} at ~80°K and the expansion of Na 1.5×10^{-3} at ~28°K. The relative frequency changes Δf/f where f was of the order of 30-40 kc/s are also given.

S.Weintr

539.219 : 532.7

1244 EUTECTIC COMPOSITIONS AND LIQUID IMMISCIBILITY IN CERTAIN BINARY ALLOYS.

ıme-Rothery and E.Anderson.
Mag.(Eighth Ser.), Vol. 5, 383-405 (April, 1960).

An examination is made of the compositions of eutectic points
e metallurgical equilibrium diagrams given by Hansen [The
stitution of Binary Alloys. 2nd Ed. New York: McGraw-Hill
8)]. A large numbers of eutectics occur at almost 0% of the
e element. With increasing atomic percentage of solute, the
er of eutectics in a given composition range diminishes
dly, until a recovery sets in an 8-10 atomic % solute. There
very few eutectics in the equiatomic region, and at inter-
iate compositions the eutectic composition distribution curves
a series of peaks at intervals of 7-8 atomic %. Stockdale's
estion that eutectic points occur at whole number ratios of the
kinds of atom is not confirmed, but certain regions of composi-
are favoured, and these include the atomic ratios of approxi-
ely 1 : 6, 1 : 3, 1 : 2 and 2 : 3. The reason for this is discussed,
free energy curves are described; some of these lead to liquid
iscibility, and examples of this are discussed.

539.219 : 539.2 : 548.5

CRYSTALLIZATION OF COPPER FROM LIQUID BISMUTH UTIONS.

See Abstr. 21162

539.23

1245 ON THE PROBLEM OF THE ANISOTROPY OF CATHODIC SPUTTERING OF DIELECTRICS.

Krokhina and G.V.Spivak.
Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 6, 694-7 (1960). In
sian.

"Cathode electronics Conference" Moscow, 1959 (see Abstr.
2 of 1960). A brief description of the experimental three-
trode tube used in the investigation is given. From the results
deduced that there is a further kind of anisotropy of cathodic
tering, caused by the nonhomogeneity of the ion beam bombar-
; the dielectric target. This leads to anisotropy of the density
e deposit on the screen and appearance of specific etch figures
he target itself. J.M.Zarzycki

539.23

1246 THE GROWTH, STRUCTURE, AND MECHANICAL PROPERTIES OF EVAPORATED METAL FILMS.

Bassett and D.W.Pashley.
st. Metals, Vol. 87, Pt 12, 449-58 (Aug., 1959).

An evaporation technique for preparing uniform continuous
le-crystal films of gold of ~150 A and upwards in thickness is
ribed. The microstructure of these films was examined by
smission electron microscopy, and they were found to contain a
density (10^{10}-10^{11}/cm^2) of dislocations. The mechanism of
ation of the films was investigated experimentally, but no direct
ence of how the dislocations are introduced was obtained. Some
e films were examined during controlled deformation inside
electron microscope; they had an abnormally high tensile
ngth, and deformed elastically up to strains of ~1%. Catastro-
fracture then occurred, the mechanism of which was deduced
the detailed examination of the specimens after fracture. The
tionship between the microstructure and the mechanical
erties of the films is discussed.

539.23 : 533.5

EVAPORATED CARBON FILMS IN SURFACE CONTAMINATION DIES IN DEMOUNTABLE VACUUM SYSTEMS.

Abstr. 19239

539.23

21247 OPTICAL TRANSMISSIVITY AND CHARACTERISTIC ENERGY LOSSES.

H.Mendlowitz.
Opt. Soc. Amer., Vol. 50, No. 7, 739-40 (July, 1960).

The optical transmissivity of thin films and their electron
racteristic energy absorption values are each interpretable in
ms of the frequency dependence of the complex dielectric con-
nt. Measurements of these two properties are quoted for Sb,
Te and are shown to be compatible in each case. Occasional
crepancies may be due to film impurities. E.A.Mussett

539.23

21248 STUDY ON VACUUM DEPOSITION OF METALS.

II. ON THE CHANGE WITH AGING TIME IN THICKNESS AND RESISTIVITY OF VACUUM DEPOSITED GOLD FILM.

Y.Fujiki.
J. Phys. Soc. Japan, Vol. 14, No. 10, 1308-13 (Oct., 1959).

(For Pt I, see Abstr. 21234 of 1960). Changes with ageing time in electrical resistivity and thickness of vacuum deposited gold film were measured on the same specimen. Kiessig's X-ray interference method was employed for the measurement of film thickness. It was observed that film thickness decreased in exactly the same manner as the resistivity. The proportionality constant between resistivity change and fractional-volume change was about 2.5 × 10^{-4} ohm cm which agreed well with the quenching experiment of gold in bulk by Bauerle and Koehler (Abstr. 4428 of 1958), and this suggests that the resistivity change in vacuum deposited gold film at room temperature is predominantly due to a vacancy mechanism just as the case of quenched material in bulk.

539.23

21249 AGEING EFFECTS IN BIMETALLIC FILMS.

C.Weaver and R.M.Hill.
Phil. Mag. (Eighth Ser.), Vol. 4, 1107-25 (Oct., 1959).

Measurements of adhesion were made on films of silver, gold, copper and aluminium with underlayers of chromium. The films were all deposited on glass microscope slides by vacuum evaporation and the adhesion measured by drawing a smoothly rounded point across the surface whilst increasing the load on the point until a clear, well-defined channel was produced. It is shown that in the case of bimetallic films, abnormally high figures may be obtained due to the formation of an intermediate layer by diffusion or intermetallic reaction. The results show a dependence upon the thickness of the chromium underlayer and time as well as upon the metal of the upper layer. Explanations are based upon a structural model for chromium films which assumes an aggregated structure formed of oxide-coated particles below 400 A thickness and a continuous metallic structure above this thickness. It is shown that intermediate layer formation occurs only when the thickness of chromium exceeds 400 A and where some degree of miscibility of the two metals exists. The rate of ageing depends upon the extent of miscibility.

539.23

21250 STUDY OF ADSORBED GAS FILMS BY ELECTRON DIFFRACTION.

L.H.Germer, E.J.Scheibner and C.D.Hartman.
Phil. Mag. (Eighth Ser.), Vol. 5, 222-36 (March, 1960).

Diffraction patterns of low energy electrons produced by a (111) face of a crystal of nickel were accelerated sufficiently to show on a fluorescent screen, where they can be photographed. Various gases at a low controlled pressures were admitted to a clean surface, and the arrangements of atoms or molecules upon the surface deduced from their diffraction patterns. Molecules of CO are adsorbed at low pressures as monolayers. They form a single-two-dimensional crystal having a spacing between molecules double that between surface nickel atoms; these molecules are completely removed from the surface by heating to 175° C. Experiments with nitrogen produced a polycrystalline monolayer having the same structure as the CO crystal. (Because of low sticking probability adequate experiments to prove that the layer is really nitrogen are difficult and have not yet been satisfactorily completed. A new type of experimental equipment seems to be required which is now being constructed). Crystal growth in this monolayer is induced by heating to 125° C; heating above 200° C results in transformation into one or the other of two polymorphic forms either of which is more stable than the original structure; heating to 300° C results in melting the monolayer without removing it, the crystalline structure returning upon cooling. Oxygen can be adsorbed in a layer several atoms or molecules thick; this shows no structure until annealed at 125° C after which the structure is that of the most complex of the polymorphic forms assigned to nitrogen; this complex structure is polycrystalline with very small individual crystals; its diffraction pattern is unchanged when the oxygen is reduced to a single monolayer by heating. No diffraction pattern has been obtained from hydrogen, although the presence of hydrogen is proved by rise in pressure when the crystal is subsequently heated.

539.23

21251 METHODS OF COVERING WITH A SEMICONDUCTING LAYER USING DIOXIDE OF TIN.

G.Baciu.

Stud. Cercetari Fiz., Vol. 10, No. 1, 211-13 (1959). In Roumanian.

Semiconductor films find important applications in laboratory work, vacuum techniques and industry; of particular interest is the requirement for such films in the acceleration chambers of betatron-synchrotron accelerators. Requirements for film characteristics are stated and existing deposition methods reviewed after which a technique is proposed which has certain advantages, including simplicity and transparent film deposits. Surface cleaning followed by film deposition using dichloride of tin in solution or in vapour form and the chemical reactions taking place are described. A.Reiss

539.23

21252 POLYMORPHIC TRANSFORMATIONS OF LITHIUM, SODIUM AND POTASSIUM IN FILMS CONDENSED ON A COLD SUBSTRATE.

B.G.Lazarev, E.E.Semenenko and A.I.Sudovtsov.

Zh. eksper. teor. Fiz., Vol. 39, No. 4(10), 1165-6 (Oct., 1960). In Russian.

Films of the three metals were condensed on glass at 4.2°K and the electrical resistance measured as a function of temperature up to 200-300°K. From the resistance—temperature curves it is concluded that each of the three metals exists in three modifications over the temperature range investigated. R.F.S.Hearmon

539.23 : 531.78 : 621.317.39 : 620.172.2

21253 VARIATION OF RESISTANCE OF A THIN METAL LAYER DEPOSITED ON A DEFORMABLE SUBSTRATE.

A.Colombani, B.Laniepce and P.Huet.

C.R. Acad. Sci., (Paris), Vol. 250, No. 24, 3946-8 (June 13, 1960). In French.

Bismuth films were deposited on mica or perspex substrates. The substrate was deformed by clamping it at one end and displacing the other end. The resistance of a film was observed with a bridge circuit, using a second evaporated film for temperature compensation. The resistance changes were proportional to the strain, and the coefficient of proportionality (k) for films on mica had a maximum value of 26 at a film thickness of 1000A, compared with a value of 2 for bulk material. The films on perspex were not as sensitive to strain, and for these k had a maximum value of 8. Such films were used successfully as displacement transducers.

C.Hilsum

X-ray and Electron Microscope Examination

539.26

21254 SILVER-ACTIVATED NITROCELLULOSE AS RECORDING MATERIAL FOR X-RAY MICROSCOPY.

S.K.Asunmaa.

Nature (London), Vol. 186, 1036-7 (June 25, 1960).

In a search for a practically grainless recording medium for microradiography the most promising material found is a film of nitrocellulose about 1000 A thick loaded with submicroscopic silver halide crystals prepared by the Goldberg process (Abstr. 987 of 1927). After exposure to X-rays the film is treated with a 2% solution of sodium cyanide in 20% methanol, which removes the silver and silver salts. The dried film is then examined in an electron microscope in order to obtain greater magnification than is possible with an optical microscope. The contrast in the electron image appears to be due to differences in mass thickness of the film as between irradiated and unirradiated regions, the role of the silver being to accelerate the degradation of the nitrocellulose under irradiation. Electron micrographs reproduced show a resolution better than 1000 A, and claimed to be better than 600 A in the original. Exposure times ranged from 10 min to 1 hr. in aluminium K and nickel L radiation. V.E.Cosslett

539.27

21255 TECHNIQUES FOR THE DIRECT EXAMINATION OF METALS BY TRANSMISSION IN THE ELECTRON MICROSCOPE. P.M.Kelly and J.Nutting.

J. Inst. Metals, Vol. 87, Pt 12, 385-91 (Aug., 1959).

Methods of preparing metal foils 100-2000A thick are classified and their advantages and disadvantages are outlined. Experimental details for the preparation of thin foils from bulk material are given in a table. Some of the factors that have to be considered in the production of clean, uniformly thin foils by electrochemical methods are discussed.

53

21256 AN OUTLINE OF THE THEORY OF DIFFRACTION CONTRAST OBSERVED AT DISLOCATIONS AND OT DEFECTS IN THIN CRYSTALS EXAMINED BY TRANSMISSION ELECTRON MICROSCOPY. M.J.Whelan.

J. Inst. Metals, Vol. 87, Pt 12, 392-405 (Aug., 1959).

The formation of contrast on transmission electron microgr of crystalline materials depends on diffraction. The contrast ne defects that produce lattice displacements (e.g. stacking faults, dislocations) is essentially a phase-contrast effect, the phase va tion arising through displacements of atoms from their normal positions. The dynamical and kinematical theories of diffraction discussed. The kinematical theory can be developed in a particu simple form with the aid of amplitude-phase diagrams; this conc is very useful in discussing qualitatively the types of contrast pa expected near dislocations where the displacements vary continu Many features of the contrast at dislocations can be explained on kinematical theory, including the nature and width of the contrast double images of dislocations, and invisible dislocations.

539

21257 ELECTRON-MICROSCOPIC STUDIES OF PRECIPITA TICN IN ALUMINIUM ALLOYS.

R.B.Nicholson, G.Thomas and J.Nutting.

J. Inst. Metals, Vol. 87, Pt 12, 429-38 (Aug., 1959).

Thin foils of alloys of aluminium with copper, silver, zinc, a magnesium were examined by transmission in the electron micro scope in the solution-treated condition and after various ageing treatments. The structures found in the supersaturated solid sol tions are described, together with those obtained on ageing to giv zones and intermediate precipitates. The role of vacancies in the various precipitation reactions in discussed. The interactions of dislocations and precipitates are described, and their relevance t three forms of age-hardening is considered.

53

21258 ELECTRON-MICROSCOPE OBSERVATIONS ON THE RECRYSTALLIZATION OF NICKEL. W.Bollmann.

J. Inst. Metals, Vol. 87, Pt 12, 439-43 (Aug., 1959).

The various stages in the recrystallization of pure nickel we studied by transmission electron microscopy and hardness measu rements. The observations on the nucleation of crystal grains ca be interpreted according to the theories of Cahn and Cottrell. Th appearance and origin of certain "growth zones" visible inside crystal grains are discussed.

539

21259 ELECTRON MICROSCOPIC OBSERVATION OF THE SUPERLATTICE IN SERPENTINE.

Y.Kamiya, M.Nonoyama and R.Uyeda.

J. Phys. Soc. Japan, Vol. 14, No. 10, 1334-46 (Oct., 1959).

The superlattice of spacing about 90A in Yu Yen Stone, a variety of serpentine, was studied. About 500 electron microgra showing fringes corresponding to the superlattice were taken, ma of which were through-focus series. The intensity profile of frin varies with the amount of defocus and it also varies from specim to specimen even at the exact focus. These phenomena are expla qualitatively by theories of image formation. "Extra" terminatin half-lines and stepped structures of fringes were studied and it w concluded that the former represent real dislocations in the crys but the latter are ghosts. The spacing of the superlattice was fou to be variable and this material is not therefore adequate for mag nification calibration of electron microscopes.

539

21260 AN ELECTRON MICROSCOPE STUDY OF GRAPHIT OXIDATION. J.A.Hedley.

Nature (London), Vol. 188, 44-5 (Oct. 1, 1960).

Preliminary studies indicate that lattice imperfections may involved in oxidation changes in graphite crystals, since attack occurs preferentially at crystal edges and cleavage steps. To ch this, a heating stage is being made to oxidize specimens during microscopic examination. R.R

539.

21261 ELECTRON MICROSCOPY OF OBJECTS AT ATMOSPHERIC PRESSURE OR AT PRESSURES WHICH PREVENT THEIR DRYING OUT. H.G.Heide.

Naturwissenchaften, Vol. 47, No. 14, 313-17 (1960). In German.

An object carrier for the Siemens Elmiskop is described isting of two thin films mounted on grids and spaced 10 μ apart. lower film carries the specimen which can be exposed to gas sures up to 760 torr. Methods of controlling and recording the pressure are given. With certain inorganic specimens, e.g. , crystals, micrographs are better than those obtained under nal conditions of high vacuum. Morever at high pressures, rast is not diminished and contamination can be prevented. With cts containing carbon, the main problems are mass losses and d build-up of contamination. In overcoming these effects, ous gases over a range of pressures have been examined and to y biological objects without total drying out, pressures of 100- torr in atmospheres of Ar,N_2 or H_2 are desirable together with le-condenser lens illumination. R.Reed

539.27

21262 FULL AND PARTIAL PARTICLE REPLICATION TECHNIQUE FOR ELECTRON MICROSCOPY.

eonhard, C.F.Cook, Jr and F.R.Anderson.

. sci. Instrum., Vol. 31, No. 11, 1181-5 (Nov., 1960).

The state of the art, and the principal problems of particle replication techniques are reviewed. The objective was to obtain the highest reliability as well as the maximum geometrical and contrast resolution for the replication technique. To this end, further improvements and complementary developments of the now-known techniques of particle replication were made. The essential stages consist of: (1) preshadowing of the sample by a refractory alloy (Pt:10%Rh) evaporated in high vacuum from a carbon rod; (2) utilizing a residual gas scattering evaporation technique (carbon in an argon atmosphere of 10^{-3} mm Hg) at twice the mean free path of the carbon (this forms a thin uniform carbon coating layer as a supporting layer which gives a minimum of contrast in the electron microscope); (3) utilizing an auxiliary strengthening layer of a subliming material (sulphur) to protect effectively the replica from deformation or fracture during the preparation procedure (auxiliary layer can later be removed by sublimation); (4) development of an easy to do partial-particle replication technique, utilizing a thermoplastic embedding technique to restrict replication to only one side of a particle which will give superposition free images.

PHYSICAL CHEMISTRY

541

21263 AVOGADRO'S CONSTANT, LOSCHMIDT'S CONSTANT, AND THE MOLE. U.Stille.

ovo Cimento Suppl., Vol. 6, No. 1, 185-213 (1957).

Avogadro's and Loschmidt's constants, N_0 and L_0, are defined l the confusion existing in the literature between these constants cussed. The values recommended for N_0, during the past ten rs, are listed and a comparison of the "experimental" and lytically determined values made. A best value of $N_0 = 6.0250 \times 10^{23}$ mole^{-1} is suggested. Owing to the uncertainty in the numeric- value of N_0 it is proposed that a mole be defined as "the quantity substance of a body containing as many equal individuals (whether y be molecules, atoms, ions, radicals etc.) as atoms are con- ned in exactly 16 g of oxygen, O^{16} isotope". This is independent the knowledge of Avogadro's number. The conversion factor ween the chemical and physical scale of atomic weights is (physical/chemical) = 1.000279. W.J.Orville-Thomas

541

21264 NEW TECHNIQUE FOR MEASUREMENT OF LOW DISSOLVED-AIR CONTENT OF WATER.

M.J.P.Manley.

it. J. appl. Phys., Vol. 11, No. 6, 228-9 (June, 1960).

This method uses an air bubble and is very suitable for the asurement of the air content of undersaturated samples. Tests ve been made of typical specimens and the limitations of the chnique are discussed.

THERMOCHEMISTRY . REACTIONS

541.12

21265 SIZE EFFECTS AMONG ISOTOPIC MOLECULES.

H.W.Joy and W.F.Libby.

chem. Phys., Vol. 33, No. 4, 1276 (Oct., 1960).

In addition to being temperature dependent the equilibrium con- ants for isotopic reactions should be pressure dependent; this is since the molal volumes of various isotopic modifications will ffer owing to the change in vibrational amplitudes with isotopic bstitution. This predicted effect should be directly measurable high pressures. W.J.Orville-Thomas

541.12

21266 THE DIFFUSION THEORY OF CHEMICAL REACTION.

J.L.Wood.

chem. Phys., Vol. 33, No. 5, 1587 (Nov., 1960).

The exact equation for the relaxation of a set of harmonic scillators, derived by Montroll and Schuler [The application of the eory of stochastic processes to chemical kinetics. University of aryland Press (1957)] leads to an expression which shows that the ate constant k is directly proportional to the friction constant β. similar dependence of k on β is found by using the classical kinetic theory of liquids. However, if the alternative treatment of chemical reaction by diffusion theory is used, k is found to be inversely proportional to β in general and independent of β when β is small. This model is rejected by the author. W.J.Orville-Thomas

541.12

21267 QUANTITATIVE CONSIDERATIONS CONCERNING CATALYSIS AT A SEMICONDUCTOR SURFACE.

C.G.B.Garrett.

J. chem. Phys., Vol. 33, No. 4, 966-79 (Oct., 1960).

The theory of charge-transfer catalysis, originally proposed by Wagner and Hauffe, is set up in quantitative form. The objects of the treatment are to write down quantitative expressions for the absolute reaction rate, to show what are the consequences of the Wagner—Hauffe mechanism insofar as they concern the adsorption properties of the individual reacting materials, and to outline an experimental programme for determining, by means of experiments on the semiconductor, alone and in association with each of the reacting substances in turn, the values prevailing in a practical case for the various parameters occuring in the theory.

541.12

21268 ON THE MECHANISM OF SULPHURIZATION OF COPPER. S.Mrowec and T.Werber.

Acta metallurgica, Vol. 7, No. 10, 696-7 (Oct., 1959).

During sulphurization of Cu in liquid sulphur a double layer of sulphide forms. The main, outer, layer grows according to the parabolic law and forms by the outward diffusion of the metal. The inner sulphide layer grows linearly with time, by vapour transfer across cracks between metal and sulphide. Decomposition of the outer sulphide layer provides the gaseous sulphur, and this appears to be the limiting step in the reaction. H.Mykura

541.12

21269 EQUILIBRIUM IN THE EXCHANGE OF TRITIUM BETWEEN AMMONIA AND HYDROGEN AND THE ZERO-POINT ENERGY DIFFERENCE BETWEEN NH_3 AND NH_2T.

J.R.Gutmann and M.Wolfsberg.

J. chem. Phys., Vol. 33, No. 5, 1592-3 (Nov., 1960).

The equilibrium in the exchange reaction involving tritium, $NH_3(g) + HT(g) = NH_2T(g) + H_2(g)$ was determined and the zero-point energy difference between NH_3 and NH_2T found to be 919 ± 21 cm^{-1}. W.J.Orville-Thomas

541.12

21270 PREPARATION AND PROPERTIES OF SCANDIUM DIHYDRIDE. J.C.McGuire and C.P.Kempter.

J. chem. Phys., Vol. 33, No. 5, 1584-5 (Nov., 1960).

Experimental details of the controlled reaction between scandium and hydrogen at 450°C to produce ScH_2 are given. Vapour pressures between 300° and 900°C and X-ray powder data for ScH_2 are tabulated and some atomic parameters calculated. G.I.W.Llewelyn

541.12

21271 FRAGMENTATION PATTERNS OF HALOGENATED PENTABORANES. I.Shapiro and H.Landesman.
J. chem. Phys., Vol. 33, No. 5, 1590-1 (Nov., 1960).

The monoisotopic mass spectra of pentaborane and some of its monohalogenated derivatives are reported. From these observations the order of relative ease of breaking certain bonds is BI > BH > BB > BBr (Cl). This order is different to that found for CH and CX bond energies in the monohalogenated benzenes viz: $\phi I < \phi Br < \phi Cl < \phi H < \phi F$ [Momigny. Bulletin de la Société Chimique de Belgique, Vol. 64, 144 (1955)]. W.J.Orville-Thomas

541.12 : 539.19

21272 EFFICIENCIES OF THIRD BODIES IN THE REACTION $H + O_2 + M = HO_2 + M$. P.G.Dickens and J.W.Linnett.
Molecular Phys., Vol. 2, No. 3, 259-63 (July, 1959).

Vibrational transition probabilities have been calculated by the Schwartz, Slawsky and Herzfeld method (Abstr. 348 of 1953) for the deactivation of HO_2^* in collision with H_2, O_2 and CO_2. The relative efficiencies of H_2, O_2 and CO_2 are compared with their third-body efficiencies found experimentally and it is concluded that the transfer of large vibrational quanta from HO_2^* is unlikely to play an important part in determinating the position of the second explosion limit of the H_2/O_2 reaction. This conclusion is at variance with the explanation put forward by Walsh (1954) of the "anomalous" third-body efficiencies of H_2O and CO_2 in this reaction.

541.12

21273 TEMPERATURE DEPENDENCE OF THE RATES OF ADDITION OF OXYGEN ATOMS TO OLEFINS.
R.J.Cvetanović.
J. chem. Phys., Vol. 33, No. 4, 1063-8 (Oct., 1960).

Relative rates of addition of oxygen atoms to several representative olefines were measured at 25° and 125°C, and the ratios of the pre-exponential factors and differences in activation energies have been calculated from the mean values of the relative rate constants at the two temperatures. The results obtained show that the differences in reactivities are primarily due to differences in the activation energies while the pre-exponential factors remain approximately constant.

541.12

21274 DECOMPOSTION OF ACTIVATED sec-BUTYL RADICALS FROM DIFFERENT SOURCES AND UNIMOLECULAR REACTION THEORY.
R.E.Harrington, B.S.Rabinovitch and H.M.Frey.
J. chem. Phys., Vol. 33, No. 4, 1271-2 (Oct., 1960).

Assuming that all internal degrees of freedom are active and that the rate of reaction varies with the total excess internal energy reasonable agreement is obtained between the observed and calculated rate constants for the unimolecular decomposition of chemically activated sec-butyl radicals formed from H and D atoms with butene-1. These findings emphasize the importance of taking vibrational anharmonicity and coupled vibrational modes into account.
W.J.Orville-Thomas

541.12

21275 EFFECT OF BINDING OF IONS AND OTHER SMALL MOLECULES ON PROTEIN STRUCTURE. VIII. ON ISOMERIZATION OF SERUM ALBUMIN IN ACIDIC MEDIA.
J.R.Cann.
J. chem. Phys., Vol. 33, No. 5, 1410-16 (Nov., 1960).

The complex electrophoretic patterns of bovine serum albumin (BSA) in 0.02 M NaCl—HCl are due to reaction boundaries arising from a set of rapidly established isomerization equilibirum and a slow, apparently irreversible reaction. The slow reaction is of only minor importance for electrophoresis in acetate buffer, although a second irreversible process occurs in this solvent at protein concentrations of 0.2% and lower. This latter reaction accounts for the bimodality of the patterns obtained at low field strength with 0.2% BSA in acetate buffer. Resolution of those peaks corresponding to the rapidly established isomerization equilibria is consequence of changes in either pH or conductance in the reaction boundary during nonideal electrophoresis. Equilibrium constants can, nevertheless, be computed from extrapolated values of the various electrophoretic mobilities without recourse to area measurements. The observations suggest the following set of consecutive isomerization equilibria:

$$N + nH^+ \rightleftharpoons F$$

$$F + mH^+ \rightleftharpoons I$$

where, as in the reaction scheme of Aoki and Foster, the F form of the protein has a larger electrophoretic mobility than the N forn whereas that of the I form is intermediate between those of the N and F forms.

541

21276 THE MODEL THERMODYNAMIC THEORY OF DEOXYRIBONUCLEIC ACID POLYCONDENSATION.
M.V.Vol'kenshtein and A.M.El'yashevich.
Dokl. Akad. Nauk SSSR, Vol. 132, No. 3, 565-7 (May 21, 1960).
In Russian.

It follows from the research of Bessman, Lehman, Simms a Kornberg [Journal of Biological Chemistry, Vol. 233, No. 1, 171 (1958)] that the reduplication synthesis of deoxyribonucleic acid (DNA) is a polycondensation (not polymerization) process. The thermodynamic nature of the reduplication is explained using the same mathematical method as in the earlier work (Abstr. 15794 of 1960) where the process was considered to be based on polyme rization of nucleotides. F.Lach

54

21277 THE THERMODYNAMICS OF THE FORMATION OF COMPLEX IONS OF ETHYLENEDIAMINETETRA-ACETIC ACID. L.A.K.Staveley and T.Randall.
Disc. Faraday Soc., No. 26, 157-63 (1958).

"Ions of the transition elements" Conference paper (see Abs 20727 of 1960). Measurements have been made of the heats of fo mation ΔH of the complexes of six trivalent metals with ethylene-diaminetetra-acetic acid (EDTA). A table is given of values of th thermodynamic parameters ΔG, ΔH and ΔS for the formation at 20°C of the complexes of EDTA with divalent and trivalent cation The only regularity is shown by the entropy of formation ΔS, whi for cations of a given charge decreases with increasing radius of the cation. A possible explanation of this is offered. It is noted the manganese + EDTA complex differs in some respects from those of the other transition metals. The connection between the size of the metallic ion and the number of coordination centres made available to the ion by the EDTA is briefly considered. It seems an over-simplification to regard the EDTA as affording ei five or six such centres symmetrically disposed about the metal ion. The thermodynamic parameters for the formation of the ra earth complexes are discussed, and it is suggested that effects hitherto thought to be due to a change from six to five in the numl of atoms of the EDTA coordinated to the metal may arise from th rather weak but not negligible effect of the ligand field on the 4f electrons. Revised estimated have been made of the standard entropies of doubly charged nickel and cobalt ions.

541.12 : 537

ION—MOLECULES REACTIONS OF THE FIFTH GROUP ELEMENT HYDRIDES. See Abstr. 19627

541.12 : 532.

OXIDATION—REDUCTION REACTIONS IN SOLUTIONS. See Abstr. 19171

ELECTROCHEMISTRY

541

21278 A REDETERMINATION OF THE VALUE OF THE FARADAY WITH THE IODINE COULOMETER (PROGRESS REPORT). D.A.MacInnes and A.R.Pray.
Nuovo Cimento Suppl., Vol. 6, No. 1, 232-41 (1957).

The silver and iodine coulometer methods and one depending the reduction of sodium oxalate are the only methods for the evalu ation of the Faraday to an accuracy of 1 in 10^4. The advantages o using iodine are stressed, viz., no isotopes, an accurate atomic weight, extreme purity, and the reversibility of the electrochemic reaction, $3I^- \rightleftharpoons I_3^- + 2e^-$, which enables the use of both anode an cathode reactions. Descriptions are given of a suitable coulomet a method of analysis, a constant current apparatus, and a device for measuring time. No new values for the Faraday are propose but the problems connected with an accurate determination appea have been solved. 7 references. H.H.Hodg

541.13 :

DETERMINATION OF THE VALUE OF THE FARADAY WIT SILVER—PERCHLORIC ACID COULOMETER. See Abstr. 19582

541.13

279 **RADIOFREQUENCY METHOD FOR THE MEASUREMENT OF CONDUCTIVE LIQUID SATURATION IN A OUS MEDIUM.** R.W.Snell.

. J. appl. Phys., Vol. 10, No. 1, 54 (Jan., 1959).

Experimental details are briefly described and some results ined using a weak salt solution graphically presented.

G.I.W.Llewelyn

541.13

280 **RELATIONS BETWEEN THE POLAROGRAPHIC HALF-WAVE POTENTIALS AND OPTICAL PROPERTIES OME INORGANIC COMPLEXES.** A.A.Vlček.

. Faraday Soc., No. 26, 164-71 (1958).

'Ions of the transition elements" Conference paper (see Abstr. 7 of 1960). The half-wave potential of the reduction waves of Co(III), Cr(III) and Rh(III) complexes of the type [Me(Y)$_5$X] shifted to more positive values with increasing difference in the ion of ligand Y and X in the spectrochemical series. The plot against $\Delta\nu$ is a straight line. Similarly, the activation energy of quation of these complexes also follows the linear plot. On s of this observation a model of the electrode process is loped. In the course of the electrode process a change in the tronic configuration of the complex takes place which is ortional to the tetragonal splitting caused by the ligand X. The nd X influences also the ligand in the trans position to itself, being more influenced by the electrode field.

541.13

1281 **ELECTROCHEMICAL AND PHOTOELECTROCHEMICAL PROCESSES ON P- AND N-Ge IN THE RANGE OF HODIC POLARIZATION.**

.Lazorenko-Manevich, N.A.Aladzhalova and V.I.Veselovskii.

l. Akad. Nauk SSSR, Vol. 133, No. 3, 620-3 (July 21, 1960). ussian.

The experiments were carried out with p-Ge (specific resistance 21.0 ohm cm) and n-Ge (1.1 and 22.9 ohm cm) in 1N KOH and H_2SO_4 in an atmosphere of H_2, the intensity of light on the trode being $\sim 10^{-1}$ cal cm^{-2} sec^{-1}. The maximum observed in overpotential versus time curve depends in both form and litude on the pretreatment of the electrode surface; the illumina- of polarized p-Ge (even during the diffusion arrest) causes a rp drop of the overpotential, which rises again when the illumina- is stopped. The illumination appears to attempt to return the face to the initial state prevailing at the moment when the current switched on. The obtained data relating to the effect of adsorbed n the photoeffect in Ge (without external current) are analysed to further causes of the maximum of the overpotential versus time ve.

F.Lachman

541.13

21282 **EFFECT OF THE SEMICONDUCTOR PROPERTIES OF OXIDE FILMS ON THE ELECTROCHEMICAL BEHAVIOUR METALS IN ELECTROLYTES IRRADIATED BY ULTRA OLET LIGHT.** A.V.Byalobzheskii and V.D.Val'kov.

kl. Akad. Nauk SSSR, Vol. 134, No. 1, 121-4 (Sept. 1, 1960). In ssian.

Steady-state electrode potentials of metal/metal-oxide elec- odes with respect to an electrolyte (NaOH or Na_2SO_4 solution) were termined for the following metals and their oxides: Zn/ZnO, /ZrO_2, Ta/Ta_2O_5, Ti/TiO_2, Ni/NiO, Cu/Cu_2O and Cd/CdO, without d with irradiation with ultraviolet light and with natural and ckened oxide film. The direction of the potential shift, due to traviolet light, depends on the conductivity type of the surface the oxide film, the negative direction being the rule for the semiconductors, and the positive direction for the p-semiconductors; e thickening of the film results in an enhanced effect (except Cd). etals with an n-type oxide film disclose an easier anodic process en irradiated, but the cathodic process is not affected at all; with e p-type film the picture is reversed.

F.Lachman

541.13

21283 **ELECTRICAL CONDUCTION IN MAGNESIUM OXIDE.** H.Schmalzried.

. chem. Phys., Vol. 33, No. 3, 940 (Sept., 1960).

Mitoff's conclusions (Abstr. 2899 of 1960) were tested using MgO of ptical quality in the cell: Pt|Fe,FeO|MgO|Ni,NiO|Pt, in a very pure $_2$ atmosphere. The e.m.f. of the cell at 1100° C is 0.285 ± 0.010 V, nd not zero, as should be expected were MgO an electronic conductor. From this experiment, and from comparison with other cells, the author concludes that MgO is predominantly an ionic conductor at 1100° C, but offers no decision as to whether cation or anion conduction prevails.

A.Avraam

541.13

21284 **COMMENTS ON DR. SCHMALZRIED'S LETTER.** S.P.Mitoff.

J. chem. Phys., Vol. 33, No. 3, 941 (Sept., 1960).

The author duplicated Schmalzried's experiment (see preceding abstract) and obtained, at 1100° C, an equilibrium potential of 0.235 V. He concludes that the MgO conduction is, indeed, predominantly ionic, but about 17% of the current is simultaneously carried by an electronic mechanism.

A.Avraam

541.13 : 532.7 : 534.22

ULTRASONIC VELOCITIES IN AQUEOUS ELECTROLYTE SOLUTIONS. See Abstr. 16769

541.13 : 534.23

THE ABSORPTION OF ULTRASOUND IN ELECTROLYTES. See Abstr. 19293

PHOTOCHEMISTRY
RADIATION CHEMISTRY

541.14

21285 **UTILIZATION OF CONCENTRATED SOLAR U.V.** F.J.Coumat and S.Martinuzzi.

J. Phys. Radium, Vol. 20, No. 6, 651 (June, 1959). In French.

An apparatus for concentrating solar radiation is briefly described and some chemical reactions which have been studied under these conditions mentioned.

G.I.W.Llewelyn

541.14

21286 **THE EFFECT OF OPTICAL RADIATION ON AN ANODICALLY-POLARIZED GERMANIUM ELECTRODE.**

A.A.Yakovleva, T.I.Borisova and V.I.Veselovskii.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 4, 889-92 (Aug. 1, 1960). In Russian.

The anodic behaviour of n-type, monocrystalline germanium, immersed in 0.1 N NaOH in a nitrogen atmosphere, was studied under illumination by monochromatic light of wavelength of 0.4-0.7 μ. The system is photosensitive, and the polarization of the anode decreases sharply with illumination. The light causes changes in the concentration and the distribution of electrons and holes in the Ge surface-layers. The photoelectrochemical current generated is directly proportional to the number of quanta absorbed on the Ge surface. The effect of the electrode thickness is not uniform, and varies with Ge samples of different ohmic resistivity.

A.Avraam

541.14

21287 **PHOTOLYSIS OF CARBON DIOXIDE.** B.H.Mahan.

J. chem. Phys., Vol. 33, No. 4, 959-65 (Oct., 1960).

The vacuum ultraviolet photolysis of carbon dioxide was investigated. Kinetic data and quantum yield measurements indicate that electronically excited (^1D) oxygen atoms are produced in the primary process at 1470 A and 1236 A. Such a primary process is consistent with the tentative spectral assignments which have been made for carbon dioxide.

541.14

21288 **LIGHT-INDUCED cis—trans ISOMERIZATION OF NITROUS ACID FORMED BY PHOTOLYSIS OF HYDRAZOIC ACID AND OXYGEN IN SOLID NITROGEN.**

J.D.Baldeschwieler and G.C.Pimentel.

J. chem. Phys., Vol. 33, No. 4, 1008-15 (Oct., 1960).

Photolysis of hydrazoic acid in solid nitrogen at 20° K with oxygen present yields both cis- and trans-nitrous acid. The identification is based on infrared detection of features of the isotopically substituted species HONO, DONO, and $HO^{18}NO^{18}$. The nitrous acid probably results from the reaction of imidogen with oxygen

$$NH + O_2 = HONO.$$

Isomerization of nitrous acid occurs in the matrix at 20° K under the influence of irradiation. Ultraviolet radiation causes the trans- to cis- reaction, probably by electronic excitation to give a random mixture of the two forms. Near infrared radiation reverses the reaction but the role of the radiation is not known. Bulk heating of the sample is not involved and a broad range of near infrared frequencies is effective. No isomerization of DONO could be detected and $HO^{18}NO^{18}$ seemed to isomerize more slowly than did HONO. Only speculative interpretations of this phenomenon can be made at this time.

541.14

21289 ABSORPTION SPECTRA OF PHOTO-OXIDE OF MESONAPHTHODIANTHRENE. H.Kuroda.

J. chem. Phys., Vol. 33, No. 5, 1586-7 (Nov., 1960).

This product is interesting because of increased electrical conductivity on oxidation (see Abstr. 18056 of 1960). Bubbling O_2 through an illuminated benzene solution of mesonaphthodianthrene causes reduced absorption at 6500 A and increased absorption at 4300 A. A similar effect is observed with iodine in place of O_2 and both effects are attributed to formation of charge transfer complexes. G.F.Lothian

541.14

21290 PHOTO-IONIZATION OF AROMATIC HYDROCARBONS IN BORIC ACID GLASSES. P.Bennema, G.J.Hoijtink, J.H.Lupinski, L.J.Oosterhoff, P.Selier and J.D.W.van Voorst.

Molecular Phys., Vol. 2, No. 4, 431-5 (Oct., 1959).

The electron spin resonance and electronic absorption spectra of various aromatic hydrocarbons was measured in boric acid, before and after exposure to the ultraviolet light of a high-pressure mercury arc. The irradiated solutions of diphenyl, phenanthrene, triphenylene, tetracene, pyrene, perylene and coronene in boric acid displayed electron spin resonance, suggesting the formation of free radicals, which is further confirmed by a study of the electronic absorption spectra.

541.14 : 533.7

THE OPTICO-ACOUSTIC EFFECT IN THE VISIBLE AND ULTRA-VIOLET REGIONS, AND ITS RELATIONSHIP WITH PHOTO-CHEMICAL REACTIONS IN GASES. See Abstr. 19215

541.15

21291 TRANSIENT SPECIES IN THE RADIOLYTIC POLY-MERIZATION OF CYANOGEN.

C.E.Melton and P.S.Rudolph.

J. chem. Phys., Vol. 33, No. 5, 1594-5 (Nov., 1960).

Mixtures of cyanogen and xenon were irradiated by 135 eV electrons at a pressure of 1 mm in the ionization chamber of a mass spectrograph. The yield of polymer ions up to $(CN)_{10}$ was measured. The polymer yield was higher in the presence of xenon: Charge transfer from Xe is excluded since the ionization potential of $(CN)_2$ is higher than that of Xe. The total intensity of negative ions increased when Xe was admixed to $(CN)_2$. This is attributed to ionization by secondary electrons from Xe and to a reaction of metastable Xe* with $(CN)_2$ to form the radicals CN· which are subsequently ionized. The addition complex $[Xe(CN)_2]^+$ was observed, which is thought to lead to further polymerization. M.Ebert

541.15

21292 EFFECTS OF GAMMA-RAYS ON AQUEOUS SOLUTION OF POLYVINYL ALCOHOL. O.Saito.

J. Phys. Soc. Japan, Vol. 14, No. 6, 792-7 (June, 1959).

The general treatment developed in previous papers (Abstr. 10211-13 of 1959) is applied to the case where an aqueous solution of polyvinyl alcohol is irradiated by gamma-rays and the results are compared with Danno's measurements (Abstr. 10351 of 1959). The behaviours of irradiated aqueous solutions of polyvinyl alcohol before and after gelation are well explained by the author's general theory. It is concluded from the analysis that end-linking instead of cross-linking occurs in the solution and also that only one molecular end out of the two which are produced by molecular scission of a polymer links with a monomer unit of another polymer molecule. It is also shown that if any impurity, especially oxygen, is not contained, the intrinsic viscosity of polyvinyl alcohol increases with radiation dose.

541.15

21293 EFFECT OF IMPURITY ON MOLECULAR LINKING OF IRRADIATED POLYMER. O.Saito.

J. Phys. Soc. Japan, Vol. 14, No. 6, 798-806 (June, 1959).

The effect of an impurity on cross-linking or end-linking is discussed theoretically. It is shown that the radiation effect on a pure polymer can be found by measuring the intrinsic viscosity ar the gel point irradiated polymer containing an impurity. The theo is compared with Chapiro's measurements (Abstr. 7468 of 1955). One of the important results is that when an impurity hinders cro linking, all the relations between physical quantities of an irradiat polymer containing an impurity can be reduced to those of the polymer containing no impurity, if use is made of a reduced radiat dose instead of the real dose. This is not the case for the effect o an impurity on end-linking. Such a difference is expected to aid in distinguishing between cross-linking and end-linking.

541.

21294 EFFECTS OF IONIZING RADIATIONS ON SYNTHETI POLYMER SOLUTIONS. S.Sugai.

J. Phys. Soc. Japan, Vol. 14, No. 11, 1573-82 (Nov., 1959).

Aqueous solutions, containing dissolved oxygen, of sodium sa of carboxy-methyl cellulose and of polyacrylic acid and so on wer irradiated with γ-rays from Co^{60} or with 90 kV X-rays, and the de generation of molecules in the solutions brought about under vario conditions was studied by viscometric, ultracentrifugal, and electrical measurements. Ideal indirect kinetics of main chain fractu through activated water was recognized in all the cases from high concentrated solutions to fairly diluted ones. In the case of extremely diluted solutions, however, free-radical recombination seems to make the reaction inefficient. From simple consideratio of these facts, certain information as to the molecular extension and form in the solution is derived. Inclusion of salts and alcohol in the solution effectively protects the degeneration due to irradia tion, which can be explained satisfactorily on the assumption of an "indirect effect". The molecular contraction and change of molecular form caused by the inclusion of salts is estimated. The irra ation effect on dilute solutions of non-electrolyte polymers was al investigated. The efficiency of chain fractures comes out not muc smaller than in the case of polyelectrolyte molecules in the same concentration range. Here the rate of fracture again seems to indicate the "indirect effect". It is concluded that electrical charge on polyelectrolyte molecules, in a certain range, are not essential for degradation and their extension is not much different from tha on non-electrolyte molecules. It was observed that, in the case of concentrated polyelectrolyte solutions containing oxygen, irradiation did not give rise to formation of gel, although micro-gel may be formed.

DISPERSIONS . COLLOIDS ADSORPTION

541.18 : 534.

THERMAL ATTENUATION OF SOUND IN A HIGHLY CONCENTRATED SUSPENSION. 19294
See Abstr.

541.18 : 55

21295 A PHOTOELECTRIC STUDY OF INDIVIDUAL FOG DROPS. J.Bricard, M.Deloncle and G.Israël.

Ann. Geophys., Vol. 15, No. 3, 415-17 (1959). In French.

This describes a method of estimating the diameter of individ fog drops in the range 10 μ to 100 μ, and also of assessing the number of drops per unit volume. The procedure is to illuminate the drop, caught on a spider web in a strong beam of light: the intensity of the light diffused by the drop is measured on the output a photo-multiplier after passing through a microscope with its axi at right angles to the illuminating beam. Curves are given showir how the luminous intensity varies with the angle between the incident beam and the axis of the microscope, and how it varies with diameter of the drop. The authors believe the method to be capab of measuring drops down to 1 μ diameter, and when an air curren with suspended drops replaces the individual drops with microscope field and an oscillograph replaces the milliammeter the pas age of each drop can be recorded. J.M.Sta

541.

21296 A STATISTICAL THERMODYNAMICS CALCULATION OF THE ADSORPTION EQUILIBRIUM OF ARGON ON GRAPHITE. A.V.Kiselev and D.P.Poshkus.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 4, 876-9 (June 1, 1960).
In Russian.

See also Proceedings of the Second International Congress on ıce Activity, London, Vol. 2, 202 (1957). Reports an approximate ılation of $\Delta\mu$ for argon on the basal face of graphite for small ›s of surface covering θ; $\Delta\mu$ for argon depended very little on area occupied by the argon molecule in the monofilm), and the rimentally obtained curve of dependence of $-\Delta\mu$ on θ lay close ; calculated curve. F.Lachman

541.18

297 KINETICS OF THE FORMATION AND SOME PROPERTIES OF OXYGEN FILMS ADSORBED ON TUNGSTEN.

Morgulis and A.G.Naumovets.

Akad. Nauk SSSR, Ser.fiz., Vol. 24, No. 6, 647-56 (1960). ıssian.

"Cathode electronics Conference" Moscow, 1959 (see Abstr. 2 of 1960). The kinetics of adsorption of O on W was studied ıeasuring the contact potential of W as a function of time under ous conditions of temperature and O pressure. The results :ated that the condensation coefficient, γ, is independent of the perature of the W strip and that the activation energy for adıtion of O on W is practically zero. No formation of surface or CO films was observed and no evidence was found of the ıation of a second film of adsorbed O with a lower (2.3-2.5 eV) ›rption energy and lower desorption temperature range (≅ 750° C), existence of which had been postulated by Gomer and Hulm str. 6487 of 1958). The current/voltage characteristics of W, ted in O, CO, or a CO + O mixture, indicated that CO molecules ›rbed on W in the presence of O are displaced by the molecules ıe latter gas. M.H.Sloboda

PHYSICAL METHODS OF CHEMICAL ANALYSIS

545 : 535.8

ERRORS OF AN ABSORPTION ANALYSER OF GAS OR LIQUID TURES. See Abstr. 19395

545

1298 ON SPECTROCHEMICAL DETERMINATION OF THORIUM BY D.C. ARC.

).Marinković.

l. Inst. Nuclear Sci. "Boris Kidrich", Vol. 9, 215-17 (March, 9).

545

21299 A METHOD FOR DETECTING HYDROGEN IN GAS MIXTURES. J.R.Young and N.R.Whetten.

v. sci. Instrum., Vol. 31, No. 10, 1112-14 (Oct., 1960).

The selective diffusion of hydrogen in palladium has been ployed to determine the presence of hydrogen qualitatively quantitatively in different gas mixtures. It was found possible to determine concentrations of hydrogen from 100% to 0.001%, or about ten parts per million, in nitrogen, with ease. Also it was found possible to detect the presence of hydrogen at a partial pressure of 10^{-7} mm Hg. This would indicate that it is possible to determine the presence of hydrogen in concentrations of one part in 10^{10} in a gas at atmospheric pressure. There is reason to believe that this technique could be extended even further perhaps to one part in 10^{14} with proper care and presently existing high vacuum techniques.

545

21300 HIGH TEMPERATURE MASS SPECTROMETER SAMPLE SYSTEM.

H.M.Shin, H.K.Hahm, S.I.Kwon, S.H.Jo and S.B.Hong.

Rev. sci. Instrum., Vol. 31, No. 11, 1200-2 (Nov., 1960).

A General Electric analytical mass spectrometer which was originally designed only for gaseous samples, has been modified so that the sample system can be converted for application to solid samples at elevated temperatures up to 1000° C. Conversion is accomplished by the complete replacement of the sample system by a magnetically operated device and a cavity furnace, the heater of which is thermally attached to the furnace body and servo-controlled to keep to the predetermined temperature within a fraction of a degree. The furnace body is a silica tube, 5 mm i.d. Replacement of the sample can be done within 10 min without breaking the major vacuum. Advantages and disadvantages compared to the Knudsen cell are also discussed.

545

21301 SEPARATION OF FISSION PRODUCTS AND CORROSION ELEMENTS ON ALUMINIUM OXIDE.

Đ.S.Nemoda.

Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 9, 95-103 (March, 1959).

Use of Al_2O_3 for the chromatographic separation of long-lived radioactive isotopes and corrosion elements from a mixture of fission products is examined. By proper choice of eluents, the mixture is separated into fractions containing one or more elements. Experiments were carried out with artificial mixtures containing the following elements: Cs^{137}, Sr^{90}—Y^{90}, Ba^{140}—La^{140}, Ce^{144}—Pr^{144}, Zr^{95}—Nb^{95}, Ru^{103}—Rh^{103}, Te, Fe, Co, Ni, Mo, Cr, Al, Pb and U.

545

21302 ON THE URANIUM-THORIUM SEPARATION WITH AN ION EXCHANGE RESIN WHICH IS SPECIFIC FOR THE THORIUM ION. J.Petit and R.Lumbroso.

C.R. Acad. Sci. (Paris), Vol. 250, No. 14, 2568-9 (April 4, 1960). In French.

Thorium 90 was concentrated by percolating a uranium salt solution through resins containing either salycilic acid or sulphosalycilic acid. R.Schnurmann

GEOPHYSICS

550.3

21303 OBSERVATIONS ON ESTUARY ICE.
P.Schwerdtfeger.
Canad. J. Phys., Vol. 38, No. 10, 1391-4 (Oct., 1960).

By observing the stratification of Churchill River estuary ice into fresh and saline parts, caused by the state of the tide at formation, the rate of growth has been estimated and compares well with that predicted by theory. L.Mackinnon

550.3 : 539.2 : 548.5

CRYSTAL ORIENTATION IN GLACIER ICE. See Abstr. 21155

550.3

21304 NOTE ON THE PAPER OF A.H.COOK, "THE EXTERNAL GRAVITY FIELD OF A ROTATING SPHEROID TO THE ORDER OF e^3". W.D.Lambert.
Geophys. J., Vol. 3, No. 3, 360-6 (Sept., 1960).

See Abstr. 8347 of 1960. This note states, without proof, formulae for the coefficients of $P_{2n}(\sin \phi)$ with no limit on n and no limit to the formal numerical accuracy of such coefficients. Some of Cook's other formulae may be simplified by a slight change in notation.

550.3 : 534.2

PROPAGATION OF ELASTIC WAVE MOTION FROM AN IMPULSIVE SOURCE ALONG A FLUID/SOLID INTERFACE. See Abstr. 19262

550.3

21305 REMANENT MAGNETISM OF LATE SECONDARY AND EARLY TERTIARY BRITISH ROCKS. R.L.Wilson.
Phil. Mag. (Eighth Ser.), Vol. 4, 750-5 (June, 1959).

The results of palaemagnetic measurements are given both for the Tertiary basalts of North Eastern Ireland, and for the Cretaceous sediments in the south of England. The direction of magnetization of the basalts is consistently shallower than the present dipole field direction by about 8°. The Cretaceous results are shown to be much less likely to be reliable, but also indicate a shallower dip than that of the present dipole field. A simple and reliable statistical treatment is developed for use with paleomagnetic data.

550.3

21306 STATISTICAL METHODS IN ROCK MAGNETISM.
S.K.Runcorn.
Phil. Mag. (Eighth Ser.), Vol. 5, 523-4 (May, 1960).

550.3

21307 PALAEOMAGNETISM OF THE BRITISH CARBONIFEROUS SYSTEM. C.W.F.Everitt and J.C.Belshé.
Phil. Mag. (Eighth Ser.), Vol. 5, 675-85 (July, 1960).

Superficially conflicting evidence has been found concerning the direction and sense of the earth's magnetic field in carboniferous times. Various explanations of the results are considered here. It is concluded that the discrepancies in direction occur because some sites underwent secondary remagnetization during the Triassic period. If this hypothesis is correct, the mean direction for the carboniferous period was 200° east of true north and 27° down; placing Britain 15° south of the equator. As regards the sense of the field it is concluded that it probably underwent a rapid series of inversions in the early part of the carboniferous period and then remained reversed for a considerable time.

550.3 : 539.2 : 538.2

A DOMAIN THEORY OF MAGNETIC GRAINS IN ROCKS.
See Abstr. 21042

550.3

21308 ECCENTRIC DIPOLES AND SPHERICAL HARMONIC ANALYSIS. L.Hurwitz.
J. geophys. Res., Vol. 65, No. 8, 2555-6 (Aug., 1960).

Explicit formulae in both closed and expanded forms are given for the potential of an eccentric dipole. The application of these formulae in examinations of the terrestrial magnetic field is discussed. R.A.Newing

550

21309 A THEORY OF POLAR GEOMAGNETIC STORMS.
J.H.Piddington.
Geophys. J., Vol. 3, No. 3, 314-32 (Sept., 1960).

For earlier work see Abstr. 9180, 12140 of 1960. The three phases of the longitude-dependent disturbance Ds, the first phase or Sc, the main phase and the preliminary reverse are all accounte for in terms of hydromagnetic waves whose Poynting fluxes are directed along the magnetic lines of force. These disturbances originate from "electromagnetic friction" between the solar wind and geomagnetic lines of force near 06 and 18 hr local time. These lines of force are bent out of their meridian planes and cause two pairs of "twist" waves to reach the Earth, being focused into relatively confined regions at high latitudes. These twists are stable or force-free and result in space-charge accumulations in the lower ionosphere where the resultant Hall current accounts for the observed disturbances. During the main phase the twists are maintained by a deformation of the geomagnetic field which was described in the earlier abstracts (the geomagnetic "tail"). Thus the tail theory accounts for both Dst and Ds main phase. It is difficult to see how any ring-current theory or other theory dependent on trapped corpuscular radiation could account for the asymmetric features of a storm. The mechanism also provides the beginning of a theory of aurorae.

550

21310 WORLD-WIDE CHARACTERISTICS OF GEOMAGNETI MICROPULSATIONS. J.A.Jacobs and K.Sinno.
Geophys. J., Vol. 3, No. 3, 333-53 (Sept., 1960).

A detailed investigation was carried out on geomagnetic micr pulsations recorded by rapid-run magnetograms during the Intern tional Geophysical Year from 17 observatories as widely distributed geographically as possible. A number of well-defined cases (14 Pt's and 3 Pc's) were investigated in detail. Diurnal and worl wide characteristics were derived and the equivalent overhead current systems which may give rise to the micropulsations were constructed. Many of the examples of Pt's can be divided into tw groups: viz. Pt^- which is a Pt associated with a negative bay in th auroral zone and Pt^+ which is a Pt either associated with a positi bay or one which appears with no bay in the auroral zone. Althoug both groups of Pt's, with their associated bays, have different characteristics, there are many points of similarity. Both classe have more or less coherent, synchronous wave forms over a wide area, i.e. they have the same period at different stations, where they are either nearly in or out of phase. It is found that Pc's consist of two different wave bands, both occurring during the da light hours. The first band contains shorter period Pc's (14-30s) with maximum amplitudes of a few gammas in moderate latitudes. They are not synchronous over wide areas. The second band contains longer period Pc's (30-90s) with maximum amplitudes in the polar regions, amounting, on occasions, to as much as a few tens gammas. They are well synchronized round the world. Attention drawn to the occurrence of long period, continuous, pulsations (called LPc's) which have a longer period than Pc's and usually appear simultaneously with Pc's in polar regions. The characteristics of micropulsations found in this investigation may throw some light on their origin. In this regard, a tentative discussion given of hydromagnetic oscillations in the outer atmosphere which are excited by solar corpuscular streams.

550

21311 SOME CHARACTERISTICS OF GEOMAGNETIC MICRO PULSATIONS (P_c). J.A.Jacobs and K.Sinno.
Nature (London), Vol. 188, 285-7 (Oct. 22, 1960).

From an examination of the micropulsations (P_c) recorded at 17 geomagnetic stations, the authors believe that P_c are of two ma classes, one class of shorter period (15-30 sec) and small amplitude, the other of longer period (30-90 sec) with amplitude up to 10 or more. The change of amplitude within each class and the latitu variation of period in the 15-30 sec class, which the authors find i their data, lead them to conclude that the shorter period P_c are caused by hydromagnetic waves in the lower part of the outer atmo sphere and the longer period P_c by hydromagnetic waves in the up regions. A third group of long-period continuous pulsations (LP_c), mainly recorded in polar regions, has a range of period (3-7 min) similar to that produced by beats of micropulsation trains, and ca be related to the same kind of high-level mechanism. J.M.Sta

550.3

312 HYDROMAGNETIC PROPAGATION OF SUDDEN COMMENCEMENTS OF MAGNETIC STORMS.

Francis, M.I.Green and A.J.Dessler.
ophys. Res., Vol. 64, No. 10, 1643-5 (Oct., 1959).
New calculations have been made of the ray paths of hydro-
netic waves travelling in the equatorial plane between points
ral earth radii distant on the noon meridian to points immediat-
bove the earth's surface, utilizing Fermat's principle. The
rence in transit time for waves generated at 6 earth radii to
h the earth's surface at the noon and midnight meridians is
l to be approx. 11 sec, in good agreement with the average
time between sudden commencements on the dark and sunlit
spheres. G.M.Brown

550.3

313 GEOPHYSICAL EFFECTS OF SOLAR CORPUSCULAR RADIATION. S.F.Singer.

Geophys., Vol. 14, No. 4, 433-7 (1958).
Magnetic storms, aurorae and cosmic ray variations are
ined from a unified theoretical point of view. The sudden
nencement of magnetic storms seems to be due to ionospheric
ents initiated by solar corpuscular radiation. The main phase
orms is explained in terms of an extra terrestrial ring current
p by the drifting motion of trapped solar particles. These
ed particles are also accelerated to high enough energies to
e aurora; the acceleration proceeds mainly by Fermi collisions
magnetohydrodynamic waves (which give rise to geomagnetic
opulsations). Decreases in cosmic ray intensity which
mpany magnetic storms are produced by a diffusive deceleration
ess in interplanetary space.

550.3

1314 GEOPHYSICAL EFFECTS OF SOLAR CORPUSCULAR RADIATION. S.F.Singer.

mos. terrest. Phys., Vol. 15, No. 1-2, 48-50 (Sept., 1959).
A new theory has been developed to explain the main features of
netic storms, aurorae, and cosmic ray effects (Forbush
eases), based on a model of interplanetary space which takes
unt of the high electron density of the outer ionosphere. In
note, some facts are enumerated, but no details are given.
e possible experiments using aircraft, balloons, rockets and
llites are suggested to test features of the theory. G.M.Brown

550.3 : 523.74

1315 STATISTICAL EFFECTS DUE TO THE CONNECTION BETWEEN FLOCCULI AND GEOMAGNETIC DISTUR-NCES. É.R.Mustel.

ron.Zh., Vol. 36, No. 2, 215-23 (1959). In Russian. English
slation in: Soviet Astron. — AJ (New York), Vol. 3, No. 2,
-7 (March-April, 1959).
The observed relationship between solar flocculi and geo-
netic storm-activity is examined statistically. It is seen that:
flocculi situated near the centre of the solar disk at central
idian passage are the principal source of M-region disturbance;
in the interval between sunspot maximum and the succeeding
imum (11 yr cycle) floccular activity is concentrated within two
gitudinal zones separated by an angular interval of ~100°; (3)
se zones are very stable, and may persist for years, although the
ation of individual flocculi within each zone may vary; (4)
ause of the duality of the floccular zones there should exist also
maxima in the statistical curve of ; M-region storm-activity.
D.R.Barber

550.3

21316 SOME REMARKS ON THE INTERACTION OF SOLAR PLASMA AND THE GEOMAGNETIC FIELD.

V.Warwick.
geophys. Res., Vol. 64, No. 4, 389-96 (April, 1959).
A brief review of the magnetohydrodynamic and ion-cloud
ories of magnetic storms and aurorae suggests some difficulties,
ncipally connected with the small scale of magnetic disturbances
m point to point on the earth's surface. Currents flowing in ion
uds closer than one earth's radius from the surface of the earth
pear to be necessary to explain the difficulties. The principal
nclusion is that such currents will flow in plasma sheets moving
ng the curved magnetic lines of force as a condition of dynamic
lance of centripetal forces. Furthermore, these currents produce
rturbation fields of the size and direction required to explain
orm-time geomagnetic variations. The plasma involved is assumed to enter the region near the earth through "horns" in incident ion clouds. The material flowing into the horns follows the lines of force to the auroral zone. Finally, these horns are supposed to develop into sheets, mathematically generated by the rotation of a line of force to the auroral zone about the earth's magnetic dipole axis. Plasma flowing along such sheets performs trajectories that concentrate in the midnight hemisphere. The high energies of auroral particles follow from the headlong collisions of such clouds in the night sky.

550.3 : 538.56 : 537.59 : 523.7 : 551.5

CATALOGUE OF DISTURBANCES IN IONOSPHERE, GEOMAGNETIC FIELD, FIELD INTENSITY OF RADIO WAVE, COSMIC RAY, SOLAR PHENOMENA AND OTHER RELATED PHENOMENA.

See Abstr. 21343

550.3 : 551.5 : 523.75

CHROMOSPHERIC FLARES ASSOCIATED WITH TYPE IV RADIO BURSTS. IONOSPHERIC AND GEOMAGNETIC EFFECTS.

See Abstr. 18760

550.3 : 537.56

STABILITY OF THE PLASMA SURROUNDING THE EARTH

See Abstr. 19676

550.3 : 538.3

THE INDUCTION OF ELECTRIC CURRENTS IN NONISOTROPIC AND NONUNIFORM THIN SPHERICAL SHELLS AND ITS APPLICATION TO A PROBLEM IN GEOMAGNETISM.

See Abstr. 19885

550.3 : 523.11 : 538.3

COSMICAL MAGNETIC FIELDS AND THE HYDROMAGNETIC THEORY OF THE DYNAMO EFFECT.

See Abstr. 19890

550.3 : 525 : 538

21317 SOME PRELIMINARY RESULTS OF THE PIONEER V MAGNETOMETER EXPERIMENT.

P.J.Coleman, Jr, C.P.Sonett, D.L.Judge and E.J.Smith.
J. geophys. Res., Vol. 65, No. 6, 1856-7 (June, 1960).

Some properties of the geomagnetic and interplanetary fields observed during the flight of the vehicle are briefly discussed: namely, the extra-terrestrial current system, the termination of the earth's magnetic field, the apparent steady interplanetary field, and the effect on the interplanetary field of enhanced solar activity and the non-geocentric Forbush decrease. It is suggested that collisionless magnetoacoustic waves may be formed in the interplanetary medium. A.Boksenberg

550.3 : 525

21318 CHARACTERISTICS OF THE EXTRATERRESTRIAL CURRENT SYSTEM: EXPLORER VI AND PIONEER V.

E.J.Smith, P.J.Coleman, Jr, D.L.Judge and C.P.Sonett.
J. geophys. Res., Vol. 65, No. 6, 1858-61 (June, 1960).

A model is hypothesized and the resultant field consisting of the geomagnetic and perturbation field (due to the current system) is computed. The comparison of these calculations with the observed fields in two regions of space leads to a strong suggestion of the existence of a ring current around the earth at altitudes of approximately 10 earth radii. A.Boksenberg

ATMOSPHERE . IONOSPHERE

(Abstracts on radiowave propagation in ionized media will also be found under Electromagnetic Waves)

551.5

21319 ARTIFICIAL SATELLITES. II. RADIO STUDIES OF ARTIFICIAL SATELLITES. F.G.Smith.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 4, 433-4 (1959).

For Pt I see Abstr. 18875 of 1960. A very brief review is given of the information obtainable from radio transmitters launched in artificial satellites. A.Boksenberg

551.5

21320 A DOUBLE FIELD MILL FOR THE MEASUREMENT OF POTENTIAL GRADIENTS IN THE ATMOSPHERE.

D.R.Currie and K.S.Kreielsheimer.
J. atmos. terrest. Phys., Vol. 19, No. 2, 126-35 (Oct., 1960).

A double field mill is described in which the top and bottom rotor are driven from a common shaft. By adjusting the relative position of the rotors it is possible to measure either the atmospheric potential gradient or the self charge of the equipment. The apparatus in conjunction with a telemetering device is to be used for the measurement of potential gradients in the free atmosphere.

551.5

21321 CONVECTION AND REFRACTIVE INDEX INHOMOGENEITIES. V.G.Plank.
J. atmos. terrest. Phys., Vol. 15, No. 3-4, 228-44 (Oct., 1959).

Half of this article reviews the various theories of the convection processes that lead to the formation of fine-day cumulus cloud: in particular the Scorer—Ludlam bubble theory is described in detail, and in the light of recent measurements of temperature and humidity from aircraft making traverses through cumulus cloud in America. The other half discusses the relationship between the structure of this kind of cloud and the atmospheric refractive index. The index is primarily a function of humidity which is uniformly at or near 100% within the cloud, so the cloud behaves as a homogeneous refractive medium. In the drier environment around the cloud the gradients of the index can be high. J.M.Stagg

551.5

21322 C.R.P.L. EXPONENTIAL REFERENCE ATMOSPHERE. B.R.Bean and G.D.Thayer.
Nat. Bur. Stand. Monogr. 4, 1-67 (1959).

The background and development of an exponential model of atmospheric radio refractivity, the C.R.P.L. Exponential Reference Atmosphere, is outlined. A set of ray tracings for the model is presented in the form of tables of refraction variables for the complete range of observed values of surface refractive index. A detailed analysis of the accuracy of the ray tracing and tabulation methods is made for these tables. The variables are presented as numbers between 1 and 10 multiplied by the appropriate power of 10, thus maintaining a maximum number of significant figures. The tables may be used for the solution of practical refraction problems involving elevation angle errors, range errors, and similar quantities.

551.5

21323 VERTICAL DISTRIBUTION OF ATMOSPHERIC OZONE FROM 9.6μ BAND OBSERVATIONS. E.Vigroux.
Ann. Geophys., Vol. 15, No. 4, 516-38 (1959). In French.

Due to changes in the method of observational processing by Goody et al., a true distribution of atmospheric ozone can be obtained, with maximum density as a parameter. The new assumptions have been tested using a chemical ozone sounding by Brewer, together with simultaneous infra-red observations.

551.5

21324 APPROXIMATE SOLUTIONS OF THE NONLINEAR EQUATION FOR VELOCITY VORTICES IN MEDIUM TROPOSHERE. V.P.Sadokov.
Dokl. Akad. Nauk SSSR, Vol. 134, No. 3, 578-81 (Sept. 21, 1960). In Russian.

The equation for H, the height of isobaric surface (using the geostrophic approximation), is:

$$\Delta H_t = -\frac{g}{l}(H, \Delta H + l),$$

where g = acceleration due to gravity, l = Coriolis parameter, $(A,B) = A_xB_y - A_yB_x$, is the Laplacian in cartesian x,y coordinates and the subscripts denote partial differentiation. The equation is solved by successive iteration of the above as a first-order differential equation with respect to time t. The k-th iterate $\Delta H_{(k)}$ contains a polynomial in several iterates of the right-hand side of the above equation. The results are illustrated with calculations of isobar distributions over Europe. J.K.Skwirzynski

551.5

21325 ARTIFICIAL RADIOACTIVITY IN THE STRATOSPHERE. C.Jehanno and J.Labeyrie.
J. Phys. Radium, Vol. 20, No. 7, 702-4 (July, 1959). In French.

A measurement of the concentration of radioactive beta products of artificial origin in the dust of atmosphere air was made up to 12 000 metres (39 500 ft) altitude in the Paris region on November 20, 1958 during the morning. The beta activity carried by the dust was on average 220 times higher per unit weight of air than the activity measured on the ground on the same day.

55

21326 STUDIES OF THE UPPER ATMOSPHERE FROM INVERCARGILL, NEW ZEALAND. I. CHARACTER
TICS OF AURORAL RADAR ECHOES AT 55 Mc/s. R.S.Unwin.
Ann. Geophys., Vol. 15, No. 3, 377-94 (1959).

Observations with a 55 Mc/s radar equipment in the south of
New Zealand are discussed. Echoes associated with magnetic act
ivity are recognized as being similar to the auroral echoes that h
been observed in the Northern Hemisphere over the past ten year
They may be divided into four major types with distinct difference
in appearance and times of occurrence. The height and thickness
of the region producing the echoes is significantly different for ea
type, though most originate from the 110-120 km level. Although
recorded during the second half of 1957 at a time of high solar ac
ivity, the frequency of occurrence appears to be much greater tha
at comparable geomagnetic latitudes in the Northern Hemisphere,
though diurnal variations are similar. Systematic motions of the
ionized regions are indicated, with a pronounced northward compo
nent before local magnetic midnight, and southward after.

551

21327 STUDIES OF THE UPPER ATMOSPHERE FROM INVERCARGILL, NEW ZEALAND. II. CORRELATIO
OF THE RADAR ECHOES AND MAGNETIC ACTIVITY. M.Gadsde
Ann. Geophys., Vol. 15, No. 3, 395-402 (1959).

Six months' operation of a 55 Mc/s radar has shown echoes
occurring in 545 cases out of a possible 1220 three-hour periods.
Analysis of this data reveals that the probability of occurrence of
echoes increases with increasing magnetic K-index, and that this
probability is intimately related to the local K-index rather than t
planetary K-index. Evidence is found for a "radar auroral zone",
whose size increases with increasing magnetic activity. It is show
that radar echoes are observed in the daytime to a less extent tha
suggested by the diurnal variation of local K-index.

551

21328 STUDIES OF THE UPPER ATMOSPHERE FROM INVERCARGILL, NEW ZEALAND. III. RADAR ECHOES AND VISUAL AURORAE. M.Gadsden.
Ann. Geophys., Vol. 15, No. 3, 403-11 (1959).

Evidence is presented and discussed that leads to the conclusi
that there is no direct connection between radar echoing regions o
served at 55 Mc/s, and visible auroral forms.

551

21329 STUDIES OF THE UPPER ATMOSPHERE FROM INVERCARGILL, NEW ZEALAND. IV. CORRELATIO
OF THE INTENSITY OF THE FORBIDDEN OXYGEN LINES IN TH
AIRGLOW AND AURORA WITH MAGNETIC ACTIVITY.
B.P.Sandford.
Ann. Geophys., Vol. 15, No. 4, 445-52 (1959).

The intensity of the (OI) lines at 5577 A and 6300 A in the air-
glow and aurora vary as similar functions of planetary K-index an
it is therefore suggested that the increased (OI) emissions in the a
glow during periods of increased magnetic activity are essentially
the same phenomena as aurora.

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21330 STUDIES OF THE UPPER ATMOSPHERE FROM INVERCARGILL, NEW ZEALAND. V. THE FREQUENCY OF OCCURRENCE OF AURORAE AND ITS DEPENDEN
ON MAGNETIC ACTIVITY AND TEMPORAL FUNCTIONS.
M.Gadsden.
Ann. Geophys., Vol. 16, No. 1, 88-104 (1960).

The results of the analysis of twenty months' records from a
all-sky camera are presented, and discussed. Correlation of the
frequency of occurrence of aurorae with magnetic K-index was fo
and it established that the correlation, while not good, is better w
local K-index than with planetary K-index. The seasonal variatio
of non-rayed forms has been found to show a significant maximum
in January, with no significant variation through the rest of the year.
significant diurnal variation was found. No 27-day recurrences in eit
auroral or magnetic activity were found for the first twelve month
of the I. G. Y., and there is no significant persistence of non-raye
aurorae from day to day. Rayed aurorae tend to persist for one d
During the night, it was found that aurorae commencing early in t
night tended to persist through the night, even though the magnetic
activity originally giving rise to the aurora did not persist.

551.5

UPPER-ATMOSPHERE WIND STUDIES BY "SKYLARK" ROCKET SODIUM EXPERIMENT. G.V.Groves.
(London), Vol. 187, 1001-2 (Sept. 17, 1960).

e first "Skylark" sodium trail experiment is briefly ed, in which the trail was laid continuously from 67 km, e trajectory vertex at 126 km, and down to 93 km. Photo- of the trail was undertaken from three roughly symmetri- aced observation posts. Small scale turbulence appears to ent to a height of 102 km causing the trail rapidly to break le above this level, the trail remains unbroken. Below 107 km motion is found to be horizontal whereas above this, the air s to be moving in large cells with vertical motions of /sec.

A.Boksenberg

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32 TURBULENCE IN THE UPPER ATMOSPHERE. N.Matuura and T.Nagata.
onosphere Res. Japan, Vol. 12, No. 2, 147-59 (June, 1958).

n attempt is made to understand the observed properties of iono- c irregularities from the viewpoint of turbulence theory. The nt interpretations are based on the theory that the atmosphere as a is in a state of equilibrium under the influence of gravity. esults give scales of the largest and the smallest irregularities ng of the order of 1 km and 30 m, respectively, for an altitude km, and of the order of 30 km and 20 km respectively, for an le of 200 km. It is concluded that the random velocities of the t and the smallest irregularities are of the order of 30 and ec, respectively, for an altitude of 100 km, and of the order m/sec for both the largest and the smallest irregularities at itude of 200 km.

551.5

333 RESULTS OBTAINED WITH ROCKET-BORNE ION SPECTROMETERS.
ohnson, J.P.Heppner, J.C.Holmes and E.B.Meadows.
Geophys., Vol. 14, No. 4, 475-82 (1958).

our high altitude research rockets carrying Bennett radio- ency ion mass spectrometers were used to determine the ent ion composition of the upper atmosphere. Results of the experiment flown in the Viking 10 rocket were complicated by ge negative charge on the rocket and by the evolution of gas. second and third experiments each has spectrometers to ure both positive and negative ions. These were flown in bee rockets. The results of the night-time flight, to 115 km, ed that ions in a sporadic E region over White Sands, New co were primarily N_2^+. Using identical instrumentation in the me flight only negative ions were detected. The predominant tive ion was 46 a.m.u.; much smaller negative ion peaks were ent at 32, 22 and 16 a.m.u. The fourth flight to 251 km, using erobee-Hi rocket took place on 20 November 1956 at 23.21 T. from Fort Churchill, Canada. Positive ion spectra were ned in the mass range 6 to 53 a.m.u. for 375 seconds while the et was above 90 km. Mass 30 (NO^+) was first detected and ained in the spectra throughout flight. Masses 32^+ and 16^+ sub- ently appeared in the spectra. A spectral peak in the mass 46^- detected by the negative ion spectrometer.

551.5 : 538.56

EXPERIMENTAL RELATIONS BETWEEN IONOSPHERIC TRUE GHT, GROUP HEIGHT, AND PHASE HEIGHT. See Abstr. 19942

551 : 538.56

GENERALIZATION OF THE APPLETON—HARTREE NETO-IONIC FORMULA. See Abstr. 11061

551.5 : 538.56

WISTED RAY PATHS IN THE IONOSPHERE. See Abstr. 11062

551.5 : 523.16

IONOSPHERIC REFRACTION IN RADIO ASTRONOM Abstr. 18655

551.5

1334 SYMPOSIUM ON THE MOVEMENT OF THE UNIFORM IONIZED GAS IN THE MAGNETIC FIELD.
. Ionosphere Space Res. Japan, Vol. 13, No. 1, 4-90 (March,).

The Ionosphere Research Committee of Japan held a sympo- n on 19 December, 1958 in Tokyo on one of the recent important projects for the fundamental physics of the ionosphere, i.e. the movement of the non-uniform ionized gas in the magnetic field. Six papers on both theoretical treatments and experimental studies were presented, and they are summarized in the following abstracts.

551.5

21335 SOME REMARKS ON MOTION OF IONOSPHERIC IRREGULARITY. N.Matuura.
Rep. Ionosphere Space Res. Japan, Vol. 13, No. 1, 4-20 (March, 1959).

Discusses the relationship between the motion of ionospheric irregularity and that of surrounding ionized gas for two cases in which the ionized gas is treated as a hydromagnetic fluid and as a fully ionized gas. One particular type of motion of irregularity is possible for the case when the scale of the irregularity is larger than the order of 100 km. For the smaller scale of the irregularity their motions are regarded as almost the same as that of surrounding positive ions. When the ionized gas can be regarded as a fully ionized gas, the particular type of motion of the irregularity is caused by gravitational force. This case corresponds to the higher part of the ionosphere and the particular type of motion of the irregularity of which the scale is smaller than the order of 1000 km is scarcely appreciable.

551.5

21336 WORLD-WIDE MEASUREMENTS OF HORIZONTAL IONOSPHERIC DRIFTS. T.Shimazaki.
Rep. Ionosphere Space Res. Japan, Vol. 13, No. 1, 21-47 (March, 1959).

Existing radio methods of measuring horizontal drifts of abnormalities of various kinds developed in the ionosphere are briefly summarized and a discussion of their merits and demerits is attempted. Daily variation curves of drift velocity obtained at various latitudes every season during I.G.Y. by the closely spaced receivers method are given. As a result, a somewhat systematic difference can be seen among daily variations observed at higher, middle, and lower latitudes and in different seasons for both E and F regions of the ionosphere. These seasonal and latitudinal changes in daily variations are discussed in detail and compared with other published results. Successful attempts have been made to explain these observational results in the E and F regions. Special attention must be given to the fact that determination of ionospheric drifts in the F regions by the method of closely spaced receivers may suffer appreciably from the effect of movements of irregularities in the E region.

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21337 IONOSPHERIC DRIFTS AT YAMAGAWA IN JAPAN. K.Tsukamoto and Y.Ogata.
Rep. Ionosphere Space Res. Japan, Vol. 13, No. 1, 48-55 (March, 1959).

I.G.Y. ionospheric drift measurement has been made at Yamagawa (Lat. 31° 12.5' N, Long. 130° 37.7' E) in Japan, using the closely-spaced receivers fading method. The results of observation for about one year from August 1957 are preliminarily analysed. Discussions are given of the drift speed, diurnal variation of the drift vector and relationship between the drift speed and geomagnetic activity.

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21338 THE MOTION OF IRREGULARITIES ON THE IONOSPHERE. T.Tsuda.
Rep. Ionosphere Space Res. Japan, Vol. 13, No. 1, 56-61 (March, 1959).

An analysis was made to determine the mean velocity of electronic density irregularities in the ionosphere using simple turbulence theory. As the kinematic viscosity is much smaller than the magnetic diffusivity in the ionosphere, all the spontaneous electromagnetic field may be neglected. Under the influence of the terrestrial magnetic field and the applied electric field, the movement of irregularities is concluded to be similar to that of the neutral wind in the E-region.

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21339 IONIZED IRREGULARITIES AND WIND MOTION IN THE IONOSPHERE. S.Kato.
Ionosphere Space Res. Japan, Vol. 13, No. 1, 62-78 (March,).

The motion of irregularities in the electron density in the of 1960). The motion of irregularities in the electron density in the ionosphere was studied with a three dimensional model. The polarization field and the drift velocity of irregularities were calculated for various values of their electron density at certain heights. It is concluded that electrodynamic effects upon the motion of irregularities are only slight in the E-region under geomagnetically quiet conditions, whereas these effects become appreciably great in the F-region and even in the E-region in high latitudes under disturbed conditions. It is noticed that, due to the action of the geomagnetic field, no irregularity moves without changing its form in the three-dimensional case, decaying in a certain life-time dependent upon its size. The minimum stable dimension of irregularities has been estimated by taking the recombination effect into account. A general discussion about stability is given for other models of irregularities. This study yields one of the theoretical grounds for "drift observation" which has been conducted to investigate the wind motion in the ionosphere. Using some observational materials a comparison was made between the wind systems deduced from the geomagnetic Sq-variations with those obtained from observation.

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21340 HORIZONTAL WINDS AND IONIZATION DRIFTS IN THE IONOSPHERE. H.Maeda.

Rep. Ionosphere Space Res. Japan, Vol. 13, No. 1, 79-90 (March, 1959).

The relation between horizontal winds (air movements) and horizontal ionization drifts (layer drifts) in the ionosphere is studied on a basis of geomagnetic data obtained during the International Polar Year, 1932-33. It is found that in the upper ionosphere (F-region) a wind is not efficient in producing drift of ionization, consequently the layer drift in this region is mainly due to an applied electric field. In the lower ionosphere (E- and D-regions), however, the induced and electrostatic fields are nearly equally efficient in producing drift, and the drift velocity due to these electric fields is very small, as compared with the wind velocity, so that it seems likely that the layer drift in E- and D-regions is almost the same as the air movement.

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21341 THREE-DIMENSIONAL CONSIDERATION FOR CURRENT-SYSTEM OF GEOMAGNETIC VARIATIONS. I. CURRENT FLOW FOR POLAR ELEMENTARY-STORM WITHIN A SPHERICAL CONDUCTING SHELL. N.Fukushima.

Rep. Ionosphere Res. Japan, Vol. 12, No. 4, 437-47 (1958).

Introduces a three-dimensional treatment of electric current flow produced by an electric dipole in a conducting region bounded by two concentric spherical surfaces, which corresponds to the idealized case for a polar elementary storm. It is shown, however, that a two-dimensional treatment is sufficiently applicable unless accurate evaluation, especially at high latitudes, is required. A.Boksenberg

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21342 IONOSPHERIC IRREGULARITIES. P.Lejay.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 27-8 (Sept., 1959). In French.

Note pointing out that although magnetic and ionospheric storms show resemblances, there are also notable differences. At a given station, ionospheric storms differ considerably, while the same storm presents different features at different places. A study of such phenomena, together with corresponding magnetic data, would be of great value. G.M.Brown

551.5 : 550.3 : 538.56 : 537.59 : 523.7

21343 CATALOGUE OF DISTURBANCES IN IONOSPHERE, GEOMAGNETIC FIELD, FIELD INTENSITY OF RADIO WAVE, COSMIC RAY, SOLAR PHENOMENA AND OTHER RELATED PHENOMENA.

Rep. Ionosphere Res. Japan, Vol. 12, Nos 1-4 (1958); Rep. Ionosphere Space Res. Japan, Vol. 13, Nos. 2-4 (1959).

Nos 24-31 of this regularly appearing catalogue, covering the period June 26, 1957 to May 13, 1959, appear in the above issues. No. 29, for April 19, 1958, is devoted to solar eclipse observations.

551.5

21344 POLAR BLACKOUTS ASSOCIATED WITH SEVERE GEOMAGNETIC STORMS ON SEPT. 13TH, 1957 AND FEB. 11TH, 1958.

Y.Hakura, Y.Takenoshita and T.Otsuki.

Rep. Ionosphere Res. Japan, Vol. 12, No. 4, 459-68 (1958).

Ionospheric disturbances observed over the polar regions in association with the solar events of 13 Sept. 1957, and 11 Feb. 19 are analysed in detail. The following conclusions are drawn: (1 about 20 hr previous to the onset of the geomagnetic storm, disti regions of anomalous ionization appear over both N and S polar c These regions produce worldwide polar blackouts i.e. sudden inc of F_{min} of vertical ionospheric soundings; (2), as the storm dev the blackout zone moves towards lower latitudes. At the main ph of the storm this zone forms a spiral-like pattern whose tip lies ward, and whose tail extends into lower latitudes of the dark hem phere; (3), it appears likely that these polar effects are caused b impingement of a cloud of charged particles on the lower ionosph Polar diagrams illustrating the main stages of polar blackout dev ment are reproduced. D.R.Ba

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21345 A STATISTICAL THEORY OF IONOSPHERIC DRIFTS. J.P.Dougherty.

Phil. Mag. (Eighth Ser.), Vol. 5, 553-70 (June, 1960).

An attempt is made to interpret the horizontal "drift velocitie observed in ionospheric fading-wave experiments by examining statistically the fluctuations in space and time of the density of io and electrons. The ionization is assumed to be convected by a turbulent flow in the neutral air, but the magnetic field and the dynamo electric field are also taken into account. The drift veloc to be calculated is defined by means of the space-time correlation function. For the D region and lower E region, the estimation of this drift velocity is found to be mathematically practicable, using certain assumptions. Results are obtained which show the relative importance of the mean aerodynamic velocity and of the electric field in determining the drift of irregularities in electron density. For higher regions, the theoretical problem is much less tractable for the reasons discussed; but it is pointed out that in this case it unlikely that the irregular behaviour can be ascribed to turbulence anyway, and that the problem of the drift velocity cannot properly be investigated until a satisfactory explanation of the cause of the irregularities is available. Some remarks are offered on the relation of this theory to the observations and to the dynamo theor

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21346 THE S.I.D. EFFECT ON THE V.H.F. SCATTER PROPAGATION ASSOCIATED WITH THE GREAT SOLAR OUTBURST OF JULY 29, 1958. T.Obayashi.

Rep. Ionosphere Res. Japan, Vol. 12, No. 3, 336-8 (Sept., 1958).

This great radio outburst was accompanied by solar flares a characterized by a remarkable fadeout of v.h.f. sky waves. The 49.68 Mc/s ionospheric scatter propagation observed over a trans mission route of length 1600 km showed a maximum decrease in intensity of more than 40 dB. During the course of the S.I.D. a ris noise level was noted which appears to be a direct effect of the ra outburst which appeared to be of Type II. It is considered that to explain the v.h.f. fadeout a hardening of the coronal X-ray spectru must be considered during a great solar flare. C.Haz

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21347 THE INVESTIGATION OF WINDS AND IRREGULARIT IN THE IONOSPHERE BY RADIO-ASTRONOMICAL METHODS. V.V.Vitkevich and Yu.L.Kokurin.

Radiotekhnika i Elektronika, Vol. 4, No. 1, 17-20 (Jan., 1959). In Russian.

The investigation was made by measuring the motion of the diffraction pattern on the earth of the emission from the radio sta in Cygnus and Cassiopeia using a 3-aerial system spaced 200 to 300 metres apart. The results obtained are evaluated. Wind velocities of the order of 70-90 m/sec were measured. R.C.Gla

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21348 IDENTIFICATION OF MODE IN LOW-FREQUENCY SWEEP IONOSPHERIC SOUNDING, AND INTERFERE PATTERNS BETWEEN OVER-LAPPING ECHOES.

A.Brunnschweiler and H.N.Carlson.

Nature (London), Vol. 188, 217-18 (Oct. 15, 1960).

A brief description of an equipment which displays the sense rotation of the wave vector of an ionospheric echo. A linearly pola zed echo is not displayed. Interference fringes between overlappi echoes are sometimes observed. The separation of these fringes gives a more accurate measure of the group height separation of the echoes than is obtained from a conventional record. Fringing is sometimes observed when the existence of a split echo would no otherwise be obvious and thus provides independent information ab the fine structure of the E-region. C.Haza

551.5

349 IONOSPHERE ELECTRON DENSITIES AND DIFFERENTIAL ABSORPTION.

eddon and J.E.Jackson.

Geophys., Vol. 14, No. 4, 456-63 (1958).

ay-time ionosphere measurements made over White Sands, Mexico using a rocket-to-ground c.w. radio propagation method eviewed. The ionosphere is a continuum rather than a series ers. One measurement of the D-region on a day of high absorp- howed a fairly sharp lower boundary at 74 km and a maximum ron density of 2000 electron/cm^3. The lower edge of the E- n has a fairly steep gradient of about 10^4 electrons/cm^3 per km. dic-E regions were always found to have a high electron ty gradient, usually with the total electron density increasing 10%. In one case, however, the increase was by a factor of Some evidence exists which indicates preferential altitudes for rmation of sporadic-E. The sporadic-E region always extended many square kilometres with little evidence of any coarse iness. The F_1 region is merely a low-gradient region in the nuum. The F_2 region profile was determined by extrapolation rocket data using P′-f records taken during the flight. The t of the maximum electron density was close to 300 km. The itional method of scaling hF_2 from P′-f records does not give rue height of the F_2 maximum electron density. The first direct surements of electron densities in the Arctic ionosphere are rted. These measurements were taken at Fort Churchill, da, during polar blackouts. One of these flights provided data 55 to 236 km. The absorption was due to abnormally high tron densities in the D-region. Charged particles must play an rtant role in the creation of this low-level ionization.

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1350 MEASUREMENT OF ELECTRON CONCENTRATION IN THE IONOSPHERE BY MEANS OF THE ROTATION HE PLANE OF POLARIZATION OF RADIO WAVES FROM KETS.

K.I.Gringauz and V.A.Rudakov.

. Akad. Nauk SSSR, Vol. 132, No. 6, 1311-14 (June 21, 1960). ssian.

The principles are outlined of a method used with geophysical ets projected 450 km and higher, vertically, and stabilized in hree possible axes of rotation. Some results, with graphs, from ocket launched on 27 August 1958 are given. Linearly polarized als on 24, 48 and 144 Mc/s,transmitted from the rocket, were ived by two ground aerials, at right-angles and horizontally rized. A graph of the signals received shows changes in the es of rotation of the planes of polarization with time. Another h gives the derived distribution of electron concentration from to 450 km. F.Quelon

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21351 NOTE ON QUIET-DAY VERTICAL CROSS-SECTIONS OF THE IONOSPHERE ALONG 75°W GEOGRAPHIC RIDIAN.

J.W.Wright.

eophys. Res., Vol. 64, No. 10, 1631-4 (Oct., 1959).

N(h) profiles have been derived, using Budden's method, from ograms obtained at a chain of stations along the 75°W meridian. e results, for a given hour, are depicted as contours of plasma quency plotted on a height/latitude vertical cross-section of the osphere, up to the height of peak density. This method of presen- ion brings out some interesting features of the distribution of ization. Two examples are illustrated: the great thickness of the osphere over the geomagnetic equator, and the region of intense ization at about 17° from the geomagnetic equator. G.M.Brown

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21352 ENTRY OF HIGH ENERGY PARTICLES INTO THE POLAR IONOSPHERE.

T.Obayashi.

. Ionosphere Space Res. Japan, Vol. 13, No. 3, 201-19 (Sept., 9).

An explanation is given for two types of enhanced ionizations he polar ionosphere associated with geomagnetic storms, viz., polar cap blackouts and the auroral zone blackouts. The former ears several hours after major type IV radio outbursts, yet, l before the onset of geomagnetic storms, while the latter is sely related to geomagnetic disturbances and auroral displays. s shown that the polar cap blackouts are caused by the invasion energetic protons of $10 \sim 100$ MeV produced in the solar corona an agitated plasma bearing magnetic fields, and that these par- les precipitate into the polar ionosphere following close the rmer orbits. For the auroral zone blackouts, an improved version of Störmer's theory is applied, in which interesting behaviour of a charged particle in the distorted geomagnetic field is revealed. The remarkable equatorward shifting of the auroral zone and world-wide increases of cosmic ray intensity during the main phase of geomagnetic storms are explained consistently by the decrease of geomagnetic cut-off for incoming particles owing to the contraction of the geomagnetic cavity.

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21353 TRUE HEIGHT AND THICKNESS OF THE E LAYER.

K.Rawer.

Ann.Geophys., Vol. 15, No. 4, 547-50 (1959). In French.

Using a procedure developed by Kelso (Abstr. 11614, 11619 of 1954), and extended by Schmerling to take account of the effect of the geomagnetic field, the author computed the true height and thickness of the E layer for part of a particular day. The results show a decrease in true thickness from 20 km in the morning to 15 km by midday, with other superposed fluctuations, some of which are attributed to vertical movements within the layer. J.M.Stagg

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21354 CLOUDS IN THE SPORADIC E-LAYER.

W.E.Dieminger.

Ann. Geophys., Vol. 15, No. 1, 23-30 (Jan.-March, 1959).

Review article, summarizing present knowledge of the cause and nature of E_s. The transparency of E_s seems to be best accounted for by postulating a cloudy structure, rather than a very thin or strongly scattering layer. The average diameter of a cloud of ionization is probably of the order of a few hundred km, while individual centres are spaced at distances of a few km. The patches of E_s exhibit systematic drifts. "Auroral E" and "meteoric E" phenomena are clearly distinguishable from ordinary E_s at non-polar latitudes, and the origin of the latter remains obscure. It is concluded that the source is not extra-terrestrial, but probably depends on some mechanism controlling the release of energy stored in the ionosphere. G.M.Brown

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21355 SOME MAGNETOIONIC PHENOMENA OF THE ARCTIC E-REGION.

J.W.Wright.

J. atmos. terrest. Phys., Vol. 18, No. 4, 276-89 (Aug., 1960).

Several unusual phenomena of E-region ionogram echoes obtained at Thule, Greenland (mag. dip 85.5°) are described. They are explained as the effects of electron collisions on the propagation of radio waves at high-magnetic latitudes. The third magnetoionic component (Z-echo) is explained in this way and several of its distinguishing features are explained and illustrated. New phenomena demonstrate the existence of an E-pause (valley above $h_{max}E$), and permit the measurement of electron densities and collision frequencies therein.

551.5

21356 THE GYRO-FREQUENCY IN THE E-LAYER ABOVE SLOUGH, ENGLAND.

W.R.Piggott.

J. atmos. terrest. Phys., Vol. 16, No. 1-2, 197-8 (Oct., 1959).

Measurements of the gyrofrequency from the separation of f_oE and f_xE are consistent with the measurements of Scott (Abstr. 6633 of 1951) but disagree with evidence from rocket measurements. It is suspected that there may be an approximation in the derivation of the equation relevant to the ground measurements. D.M.Schlapp

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21357 A WORLD-WIDE SEMI-ANNUAL CYCLE IN THE E-LAYER OF THE IONOSPHERE.

C.N.Minnis and G.H.Bazzard.

J. atmos.terrest. Phys., Vol. 18, No. 4, 306-8 (Aug., 1960).

A study of the E-layer character figure for eight stations in the north and south hemispheres has disclosed an unexpected semi-annual cycle the variations in which have the same sign in both hemispheres. The amplitude of the cycle is about ±15% near the maximum of the solar cycle but vanishes at the minimum. Its origin has not yet been discovered but several possibilities are discussed.

551.5

21358 LONGITUDE EFFECT IN TEMPERATE ZONE SPORADIC E AND THE EARTH'S MAGNETIC FIELD.

L.H.Heisler and J.D.Whitehead.

Nature (London), Vol. 187, 676-7 (Aug. 20, 1960).

A correlation is demonstrated between the horizontal component of the earth's magnetic field and the occurrence of $f_0Es > 5$ Mc/s for various stations throughout the world. The result shows that the longitude variation of Es depends on the local magnetic field, and is thereby important in considering the origin of Es. H.J.A.Chivers

551.5 : 621.391.812.63

21359 VERTICAL DRIFT IN THE E-LAYER OF THE IONOSPHERE DURING GEOMAGNETIC DISTURBANCES.

H.Kohl.

Arch. elekt. Übertragung, Vol. 14, No. 7, 314-16 (July, 1960). In German.

Electric fields appear in the ionosphere during geomagnetic disturbances and cause vertical drift of the ionized plasma. Motion equations of the plasma in a magnetic fields are solved by taking into account the relatively high density of the neutral gas which must cause a braking action. It is found that drift velocity is only a few dm/sec and therefore the total rise of the E-layer is too small to be measured by ionospheric recorders. J.M.Silberstein

551.5

21360 GLOBAL MORPHOLOGY OF THE E- AND F1-LAYERS OF THE IONOSPHERE. E.Appleton.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 9-12 (Sept., 1959).

Summary of results indicating small departures from Chapman theory behaviour in the E and F1 layers, and their interpretation in terms of geomagnetic distortion. See also following abstract. G.M.Brown

551.5

21361 VERTICAL DRIFT EFFECTS IN REGION-E. W.J.G.Beynon.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 13-20 (Sept., 1959).

Summary of some of the results of Beynon and Brown (Abstr. 6455 of 1960), with additions, in which the influence of the S_q current system on the E-layer is made evident. Some of the characteristics of E_s ionization are also discussed. The last two pages summarize points from the discussion which followed this and Appleton's paper (preceding abstract). G.M.Brown

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21362 THE MORPHOLOGY OF THE LOWER IONOSPHERIC REGION IN AURORAL LATITUDES. S.Matsushita.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 68-72 (Sept., 1959).

Discussion of the relation between geomagnetic bays, black-outs and Es-blanketing of F2 at auroral latitudes. Two different kinds of blackout are distinguished: "gradual blackout" which occurs only at night, and "sudden blackout" in the daytime. It appears that the latter is due to increased ionization below the E layer, probably produced by X-rays generated by the primary bombarding solar particles, while the "gradual blackout" ionization occurs at a greater height. G.M.Brown

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21363 POSSIBILITY OF DETECTING IONOSPHERIC DRIFTS FROM OCCURRENCE OF SPREAD F ECHOES AT LOW LATITUDES. R.W.Knecht.

Nature (London), Vol. 187, 927 (Sept. 10, 1960).

Times of occurrence of spread F echoes taken at four stations in Peru strongly suggested that the patches of irregularities thought to be producing the spread F were often observed successively at each of the stations. A mean apparent drift velocity of 135 m/s towards the east was obtained, agreeing well with the value of Skinner, Hope and Wright for the same period (Abstr. 4138 of 1959). A.Boksenberg

551.5

21364 SPREAD-F IN THE IONOSPHERE OVER AHMEDABAD DURING THE YEARS 1954-57. K.M.Kotadia.

Proc. Indian Acad. Sci. A, Vol. 50, No. 4, 259-71 (Oct., 1959).

From a study of spread-F during this period of increasing sunspot activity, it was found that the time of its maximum occurence receded from 03 hr in low sunspot years to an hour or two before midnight in high sunspot years. This was particularly marked in the winter and equinoctial months. The maximum spread-F activity found in summer in minimum sunspot years occurred in the equinoxes in maximum sunspot years. The frequency of occurrence of spread-F was found to be a maximum when hpF_2 was in the range 300-350 km. F-scatter and F_2-stratification were found to be anticorrelated both in their diurnal and seasonal variations. The ge- ral trend was towards decreased spread-F with increased sunsp activity. It is concluded that: (1) spread-F at Ahmedabad geoma netic latitude (Φ = 13.6° N) undergoes variations similar to those equatorial stations, more so in high sunspot years; (2) the chang over from a low-latitude type to a middle-latitude type of variat of spread-F takes place at about geomagnetic latitude 22°; (3) spread-F at Ahmedabad decreases with increase in magnetic activity, which is the reverse of that observed at high latitudes.

551.5 : 55

21365 GEOMAGNETIC AND SUNSPOT INFLUENCES ON SPREAD-F IN BAGUIO.

V.Marasigan.

J. atmos. terrest. Phys., Vol. 18, No. 2-3, 257-8 (June, 1960).

Observations at Baguio, Philippines, confirm the previously reported tendency for geomagnetic disturbance to reduce the fre quency of occurrence of spread-F ionization (Abstr. 7627 of 195 This tendency is greater, and more consistent in years of high s spot number; and the seasonal variation of spread-F occurrence changes with spot-number independently of geomagnetic activity. D.R.Bar

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21366 COSMIC RADIO NOISE ABSORPTION ON 25 Mc/s AND F SCATTER. K.R.Ramanathan and R.V.Bhonsle

J. geophys. Res., Vol. 64, No. 10, 1635-7 (Oct., 1959).

Measurements at Ahmedabad of the total attenuation of cosmi radio noise on 25 Mc/s (Abstr. 4129 of 1959) have been analysed into D-region and F2-region components. An interesting feature the latter is a sharp rise in attenuation shortly after sunset, reac a maximum at 21-2 hrs. It is pointed out that the features of this increase agree with the observations by Bateman et al. of the anomalous evening enhancements of scattered v.h.f. signals, whic they attributed to low latitude spread-F. G.M.Bro

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21367 IONOSPHERIC ABSORPTION AND ELECTRON COLLISIONAL FREQUENCY IN THE F REGION.

Y.S.N.Murty, R.N.Singh and S.R.Khastgir.

J. sci.industr. Res., Vol. 18 A, No. 11, 507-9 (Nov., 1959).

The total absorption of radio waves proceeding vertically upwards through the E layer and suffering reflection from the F layer was determined over a range of frequencies from nearly 3 to 7 Mc/s by measuring the most probable values of the signal amplitudes of the first and second orders of ionospheric reflecti In some measurements, continuous photographic records of the signal amplitudes of the first and second orders of ionospheric reflection were simultaneously taken and the method proved usef for the quick and accurate study of the variation of the ionospheri absorption with frequency. The electron collisional frequency (ν) in the F region was calculated by applying Appleton's modified formula (connecting the electron collisional frequency with refle coefficient and group path) near the critical penetration frequenc The mean value of ν in the F region was found to be 4kc/s which agrees well with the values obtained by other workers.

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21368 DETERMINATION OF ELECTRON DENSITY PROFIL IN THE IONOSPHERE. (CASE WHERE EFFECT OF MAGNETIC FIELD IS NEGLECTED). K.Rawer and C.Taïeb.

C.R.Acad. Sci. (Paris), Vol. 251, No. 4, 576-8 (July 25, 1960). In French.

An approximate method is given whereby F region profiles c be determined using only standard parameters given in ionospher bulletins. The method assumes that only the F layer is present a that it has a parabolic profile. D.M.Schla

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21369 DETERMINATION OF ELECTRON DENSITY PROFI IN THE IONOSPHERE. (CASE WHERE EFFECT OF EARTH'S MAGNETIC FIELD IS TAKEN INTO ACCOUNT).

K.Rawer and C.Taïeb.

C.R. Acad. Sci. (Paris), Vol. 251, No. 5, 760-1 (Aug. 1, 1960). I French.

An extension of the procedure described in the preceding abstract to the case where the effect of the magnetic field is included. D.M.Sch

551.5

70

IRREGULARITIES AND MOVEMENTS IN THE F-REGION.

K.Rawer.

ıos. terrest. Phys., Vol. 15, No. 1-2, 38-42 (Sept., 1959).

ine film observation of ionograms at a rate of about 5 per
e reveal perturbations on the F-trace which move rapidly
the trace towards lower frequencies. An interpretation is
sted in terms of "retarded sound waves" (shock waves coming
outside into the earth's atmosphere in which the movement of
cles is controlled by the earth's magnetic field). Associated
mena are the transitory appearance of a "G-layer" at the
ning of the event, and a depression of the characteristic MUF
-F2 immediately before. G.M.Brown

551.5

371

SINGLE AND DOUBLE INFLEXIONS ON THE F-TRACE.

V.Marasigan.

nos. terrest. Phys., Vol. 16, No. 1-2, 193-6 (Oct., 1959).

ın attempt is made to explain the single and double inflexions
. occur on F-layer ionograms during the daytime in terms of
ppleton—Lyon theory (Abstr. 5765 of 1955) of the height
etween the peaks of production and ion density. D.M.Schlapp

551.5

372

ECLIPSE EFFECTS ON THE F-LAYER AT SUNRISE.

C.S.G.K.Setty.

mos. terrest. Phys., Vol. 19, No. 2, 73-81 (Oct., 1960).

Eclipse effects observed on 1 September 1951 at Derwood, Mary-
, U.S.A. were studied. The h'(f) curves taken during the eclipse
od and on control days were analysed for N(h) and N(t) curves at
ries of heights. The eclipse variation of N computed from the
rol day data does not coincide with the observed variation. How-
, if the assumption is made that the electron production rates on
eclipse day were about 30% higher than those on the succeeding
rol day the agreement between the observed and computed eclipse
ations of N is improved. Further, if it is assumed that at the
of totality 30% of the radiation was unobscured, in other words
e 30% of the radiation originates in a region beyond the visible
r disk, then the agreement between the observed and computed
pse variations is excellent. Some solar data in favour of both
e assumptions are given and their validity in the light of
eral other known eclipses is discussed.

551.5

1373

A PRE-SUNRISE PHENOMENON AND THE PRESENCE OF NEGATIVE IONS IN THE F-REGION OF THE IONOSPHERE.

G.K.Setty.

mos. terrest. Phys., Vol. 19, No. 2, 88-94 (Oct., 1960).

Frequent observations made on the F-layer with a panoramic ionos-
e recorder and a detailed analysis of the observations, using Shinn's
hod to reduce the observed h'(f) curves to N(h) and N(t) curves at a
es of heights, has shown the existence of a pre-sunrise increase of
zation which can be attributed to the presence of negative ions in the
yer at night. Most favourable days for such observations are in the
ths of May and July when there is a big interval between the time of
ise at the layer and that when the main photo-ionization process be-
es effective. If the assumption is made that the electrons are relea-
from the negative ions formed at night by the visible radiation from
sun then the calculated rate of production of electrons, from the ob-
ved N(t) curves, yields a value for the coefficient of detachment β for
nic oxygen which is in excellent agreement with the theoretical value
en by Bates and Massey (Abstr. 899 of 1947; 361 of 1948). A small
y in the time of reversal of the observed N(t) curve and the layer
rise allows an estimation of the height of the "screening" layer to be
le. The estimated value agrees well with those reported earlier for
lower ionospheric layers.

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21374

SOME STUDIES OF BIFURCATION OF THE IONOSPHERIC F-LAYER INTO F1 AND F2.

C.S.G.K.Setty.

atmos. terrest. Phys., Vol. 19, No. 2, 82-7 (Oct., 1960).

Observations made at frequent intervals with a panoramic iono-
here recorder at Cambridge during the sunspot minimum years
54 and 1955 shows that the splitting of the F-layer into F1 and F2
curs at the time of ground sunrise. The F1-layer is usually present
roughout the year except in the winter. The height at which the
-layer maximum occurs remains constant for at least 2 hr after
first appears with the sunrise. Also it seems to vary with the
ason, being highest in summer and lowest in winter. The
-layer under storm conditions on 25 February 1956, following the
great cosmic ray burst that was observed on 23 February, developed a subsidiary maximum which under normal conditions would be identified as the F1-layer. No such substratification was noticed on the subsequent days. Under quasi-equilibrium conditions, which occur during the midday, it can be shown from the simple Chapman theory of layer formation, with an attachment-like law for the loss-process, that there should be no maximum of ionization under certain conditions of the atmospheric scale-heights. However, a numerical solution of the continuity equation for electrons shows that a maximum of ionization does occur at sunrise when the equilibrium condition is not yet reached.

551.5

21375

A SYNOPTIC STUDY OF THE F2-REGION OF THE IONOSPHERE IN THE ASIAN ZONE.

R.G.Rastogi.

J. atmos. terrest. Phys., Vol. 18, No. 4, 315-30 (Aug., 1960).

A detailed study of the variation of f_oF2 at ionospheric stations in the Asian zone shows that the region of maximum f_oF2 varies with the time of the day as well as with the season. The anomalous belt of the F2-layer develops at the equator near sunrise and slowly expands with the progress of the day, and is most extended during the afternoon hours. Multiple splittings in the F-region and other abnormal P'-f recordings observed at middle latitudes are shown to be associated with some striking features in the synoptic distribution of f_oF2. The abnormal recordings can be explained on the basis of horizontal movements in the ionosphere, being in the east—west direction before sunrise in the morning or after sunset in the evening, and in the north—south direction during the forenoon.

551.5

21376

MORPHOLOGY OF THE IONOSPHERIC F2 DISTURBANCES IN THE POLAR REGION.

T.Sato.

Rep. Ionosphere Space Res. Japan, Vol. 13, No. 2, 91-104 (June, 1959).

A study was made of the morphology of the F2 disturbance in the polar region (polar cap and auroral region) associated with geomagnetic storms, using the I.G.Y. ionospheric data from July 1957 to February 1958. An analysis is made of individual severe geomagnetic storms, especially of five great storms which occurred in September 1957 and February 1958, and the statistical characteristics are also shown. The results are as follows: (i) The variations of the f_oF2 over the polar region start at nearly the same time as, or within a few hours after, the time of the sudden commencement of the geomagnetic storm. They take place even near the magnetic pole, and near the geographic pole in winter. (ii) The disturbance variations are most severe on the first day, continue during several days and cease with the decreasing geomagnetic activity. The type of variations are similar throughout the latitudes. (iii) The maximum depression of the f_oF2 comes at or after noon and recovers at night in winter and equinox, but the maximum seems to disappear in summer. (iv) The amplitude of the maximum depression is greatest in winter, and smaller in the polar cap than in the auroral zone. It is noted that the percentage of the depression is nearly the same in each season. (v) The disturbance in the polar cap seems to be simply the transfer of that in the auroral zone.

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21377

RECOMBINATION IN THE F2-LAYER AND THE OXYGEN RED LINES IN THE AIRGLOW.

J.W.Chamberlain.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 96-8 (Sept., 1959).

Evidence has accumulated that the nightglow red lines of oxygen originate in the F-region, and hence support the theory that their excitation is due to dissociative recombination of O_2^+ ions and electrons. It appears that the evening twilight enhancement of the red lines can also be accounted for in terms of this mechanism, rather than that of resonance scattering. G.M.Brown

551.5

21378

THE DIURNAL SUNLIT COMPONENT OF F2 LAYER IONIZATION DURING THE FIRST HALF OF THE DAY.

A.I.Likhachev.

Astron. Zh., Vol. 34, No. 1, 135-9 (1960). In Russian. English translation in: Soviet Astron.—A.J.(New York), Vol. 4, No. 1, 129-33 (July-Aug., 1960).

Results are given of research on the diurnal variation of ionization. It is shown that the variation in the diurnal sunlit component during a year correlates excellently with the sine of the sun's zenith angle. The annual amplitudes of the diurnal sunlit component are correctly determined by the mean annual values of sunspot numbers. During the summer months, ionization in the F2 layer reaches saturation at the latitude of Tomsk. Introduction of the parameter $f^{0}F2\sim$ for the F2 ionization layer permits a sufficiently accurate prediction of the state of ionization over a long period.

551.5

21379 GEOMAGNETIC STORMS AND THE EARTH'S OUTER ATMOSPHERE. T.Obayashi.

Rep. Ionosphere Res. Japan, Vol. 12, No. 3, 301-35 (Sept., 1958).

A model of ion density from 2 to 5 earth radii is derived by explaining observations of geomagnetic pulsations in terms of hydromagnetic oscillations; the model agrees well with those derived from whistler data by other workers. The great geomagnetic storm of Feb. 11, 1958, is analysed in some detail. It is concluded that the geomagnetic field is normally confined to a cavity of radius about 10 earth radii, surrounding the earth. During a geomagnetic storm the size of this cavity is considerably reduced, the more the severer the storm. This result is shown to fit in with observations of aurorae at low latitudes and ionospheric disturbances. An attempt is also made to construct a model of the distribution of gas in interplanetary space and it is shown that corpuscular streams emitted from the sun may be slowed down considerably by interplanetary gas.

D.M.Schlapp

551.5

21380 DETERMINATION OF THE BALMER DECREMENT IN AURORAL SPECTRA. F.K.Shuiskaya.

Astron. Zh., Vol. 37, No. 1, 186-7 (1960). In Russian. English translation in: Soviet Astron.–AJ (New York), Vol. 4, No. 1, 178-9 (July-Aug., 1960).

H_α, H_β, and H_γ were photographed in three auroral displays (dispersion 250 A/mm). The mean value of the decrement H_α:H_β:H_γ was 3.0 : 1 : 0.8.

551.5

21381 OXYGEN RED LINE IN THE NIGHT AIRGLOW AND IONOSPHERIC F2 REGION.

M.Huruhata, T.Nakamura, H.Tanabe and T.Tohmatsu.

Rep. Ionosphere Space Res. Japan, Vol. 13, No. 4, 283-9 (Dec., 1959).

Spectroscopic data of oxygen red line, [OI]λ6300 in the nightglow are compared with the simultaneous ionospheric information. A statistical analysis of the data shows that the intensity of the red radiation is approximately proportional to the maximum electron density in the F2 region. The height of F2 region also seems to have a secondary effect on the brightness. Since the fluctuation of observed intensities from an empirical value statistically given by f_oF2, h'F and h_pF2 is appreciably great, more detailed information on the structure of F2 region would be necessary to interpret the momentary variation of the red radiation. The latitude dependence of the intensity is investigated by using the spectroscopic records at zenith distance 75° in the directions of both north and south. The southern sky at Maruyama Station is usually brighter than the northern sky. This trend is generally conspicuous during the first part of night and it dimishes towards dawn. By comparing with the ionospheric data at four stations in Japan, it has been concluded that this latitudinal effect of oxygen red line is primarily due to the latitudinal gradient of electron density in the F2 region. A suggestion is given on the possible correlation of the latitudinal distribution with the geomagnetic activity.

551.5

21382 EXCITATION OF THE SODIUM TWILIGHT GLOW. T.M.Donahue and V.R.Stull.

Ann. Geophys., Vol. 15, No. 4, 481-515 (1959).

A calculation of the intensity of the sodium D lines and the D_2/D_1 ratio in twilight as a function of angle of solar depression and sodium abundance is presented. Resonance and Rayleigh scattering, single and multiple, as well as absorption and refraction, are taken into account. The incident solar intensity is computed including the Doppler effect of the motion of the earth on the Fraunhofer lines.

55

21383 SYSTEMATIC VARIATIONS OF THE INTENSITY OF T PRINCIPAL RADIATIONS OF THE LIGHT OF THE NI SKY AT THE HAUTE-PROVENCE OBSERVATORY. D.Barbier.

Ann. Geophys., Vol. 15, No. 3, 412-14 (1959). In French.

The observations cover the period, July 1953 to June, 1958, ar refer to the night-glow emissions at wavelengths, 3670, 4400, 5260 5577, 5900, 6300, and 6700 A. Both the annual fluctuation, and the variation during the course of the night are studied in the period fr sunspot minimum to maximum. The emissions at 5577 A (OI), and those belonging to the related group (3670, 4400, 5260 A) all exhibit strong positive correlation with annual sunspot number; whereas th correlation is absent, or very weak, for the radiations at 5900 A (Na I), and at 6300, 6700 A (OH).

D.R.Barb

551

21384 INFRARED SPECTRUM OF THE NIGHT SKY UP TO 3.4 μ. V.I.Moroz.

Astron. Zh., Vol. 37, No. 1, 123-30 (1960). In Russian. English translation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, 118- (July-Aug., 1960).

An i.r. spectrometer with a PbS photoconductive cell was used to record the nightglow emission from 1.2 to 3.4 μ. In the 1.2-2.0 region, the results were found to be in excellent agreement with th findings of other workers. The region λ > 2.0 μ was studied for th first time. No intense emission bands of any kind were found in th 2.1-2.5 μ region, which is comparatively free from tropospheric a sorption lines. A weak maximum near 2.1-2.2 μ was identified wit the 9—7 OH band at 2.145 μ. The thermal-emission spectrum of th troposphere was recorded in the 2.6-3.4 μ region. Near 3.2 μ, a clearly delineated band structure was observed, and was identified with the inverted absorption spectrum of water vapour in the tropo sphere. Absolute intensities were found for the 8—5, 3—1, 4—2, 5—3, and 9—7 bands of OH, and were compared with theoretical pr dictions. The intensity ratios of bands having common upper level obtained by drawing upon observational data reported by other authors, show better agreement with the Einstein coefficients computed by Shklovskii (1951) than with the second approximation of Heaps and Herzberg (Abstr. 738 of 1953). The intensities of the bands which were not studied (3—2, 4—3, 5—4, and 9—8) were calc lated, and the possibility of studying the band sequence ΔV = 1 is discussed.

551

21385 CONTRIBUTION TO THE STUDY OF THE STRUCTUR OF THE LAYER EMITTING THE 5577 LINE IN THE NIGHT SKY. D.Barbier and J.Glaume.

Ann. Geophys., Vol. 15, No. 2, 266-71 (1959). In French.

A discussion of the results of a photometric study of the O I night airglow emission at 5577 A made with a photoelectric scanni photometer and interferential filter at the Haute-Provence Observatory, France, between January 1954 and December 1957. A total of 568 scans around the horizon at zenith distance 75° has been analysed, and grouped in four categories: (1) 320 observations showing a single intensity maximum; (2) 121 observations exhibiti two maxima; (3) 77 observations that show three, or more maxima during the scan; and (4) a further 50 observations for which the intensity of emission remained sensibly constant at all azimuths. In general, the 5577 A emission was more intense to the south of the station than to the north. The results are compared with similar data obtained at Tamanrasset (Sahara Desert), and at Cac Peak, and Sacramento Peak (U.S.A.) during the period of the I.G.Y

D.R.Barb

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21386 CONTINUOUS EMISSION SPECTRA OF THE TERRESTRIAL ATMOSPHERE AT 9.6 μ. E.Vigroux.

Ann. Geophys., Vol. 15, No. 4, 453-60 (1959). In French.

Ascribing this emission to water vapour allows the absorption factor to be computed. Absorption spectra in the Φ band of H_2O ar used to determine the water content which is necessary for the computation.

551.5 : 535

21387 STUDY OF THE ULTRAVIOLET RADIATION OF THE SKY. I. SPECTROPHOTOMETER WITH POLARIMETER FOR THE ZENITH SKY. J.Lenoble.

Rev Opt., Vol. 38, No. 6, 282-9 (June, 1959). In French.

A recording photoelectric spectrophotometer was built to investigate the ultraviolet luminance of the zenith sky. The ultra-monochromator and the 20-stage electron multiplier are under ter outside the laboratory, while the recorder and power supply aced inside. The instrument is automatically controlled and ecord spectra at several previously selected altitudes of the A modulating polarimeter and a compensating plate are orated for measuring the polarized light.

551.5 : 523.5

88
VISUAL AND PHOTOGRAPHIC OBSERVATIONS OF METEORS AND NOCTILUCENT CLOUDS.

illman.

phys. Res., Vol. 64, No. 12, 2122-8 (Dec., 1959).

luid Mechanics in Ionosphere, Cornell University, July, 1959 bstr. 10417 of 1960). The visible paths of meteors appear lly in the region from 110 km to 60 km above sea level. The ns between meteor height and meteor velocity, brightness, gle of the path to the vertical are discussed. Persistent meteor show a height distribution similar to that of meteors and differential wind motions of various types, as well as giving ce of a rapid increase in the train diameter during the first inutes. A vertical spacing of about 6 km between major wind nts seems typical. Noctilucent clouds exhibit velocities com- e to those of meteor trains and often reveal a pattern of y parallel lines with a spacing of 9 km.

551.5

389
THE SOLAR CONSTANT.

R.Tousey.

Cimento Suppl., Vol. 6, No. 1, 413-18 (1957).

The determination of the absolute value of the solar constant is ally discussed, consideration being given to the "zero air- " atmospheric absorption corrections to the bolometric curves ltraviolet and infrared regions of the solar spectrum. Various ed numerical data, including the Smithsonian values, are dered, and it is concluded that the most probable value of the constant is 2.00 ± 0.02. D.R.Barber

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390
DETERMINATION OF THE EARTH'S ALBEDO.

É.K.Dzhasȳbekova, V.M.Kazachevskii and A.V.Kharitonov.

n. Zh., Vol. 37, No. 1, 131-4 (1960). In Russian. English lation in: Soviet Astron.—AJ (New York), Vol. 4, No. 1, (July-Aug., 1960).

Briefly discussed the principles of the determination of the o of the earth by observations of the earthlight on the moon. nstrument and procedure used in the observations are des- d. Results of laboratory studies of the instrument are also . Albedo values for 17 dates are tabulated, with the geographic ion of the moon indicated for each date. The mean value for lbedo was found to be 0.391 ± 0.014. An accompanying table all known determinations of the earth's albedo.

551.5 : 535.31

ATMOSPHERIC SEEING: TELESCOPIC PERFORMANCE OF UNIFORM ATMOSPHERE. See Abstr. 19361

551.5

391
AIRCRAFT OBSERVATIONS OF CONVECTIVE CLOUD ELECTRIFICATION.

D.R.Fitzgerald and H.R.Byers.

mos. terrest. Phys., Vol. 15, No. 3-4, 254-60 (Oct., 1959).

Discusses potential gradients in clouds measured with field rs mounted in the wing tips of an aircraft. Strong electric s were detected in only one out of several hundred flights through ical clouds and the conditions favouring static discharges in such ds are discussed. Reasons are advanced for assuming that clouds are predominantly negatively charged in the regions of test liquid water content. After precipitation positive charges ominated in strong-field clouds. A field rise was observed in clouds within 5-10 minutes from precipitation. R.H.Golde

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1392
ELECTRIC FIELD-CHANGE STUDIES OF LIGHTNING.

L.G.Smith.

tmos. terrest. Phys., Vol. 15, No. 3-4, 251-2 (Oct., 1959).

Leader strokes, preceding return strokes of earth discharges, initiated in a cloud about 100 msec before the first leader rges below the cloud. Slow junction streamers between com- ent strokes tap successively higher charge regions. In contrast to earth strokes, cloud strokes have no superimposed fast field changes and are characterized by a most frequent duration of 0.3 sec. Their vertical length is of the order of 5 km. R.H.Golde

551.5 : 621.315.98

21393
ELECTROMAGNETIC STANDING WAVES AND BALL LIGHTNING.

L.Tonks.

Nature (London), Vol. 187, 1013-14 (Sept. 17, 1960).

Points out difficulties for the Kapitza theory (Abstr. 1771 of 1956) to account for the following: (a) buoyancy in air of the plasma ball raised to a high temperature; (b) generation of the high short-wave power required for producing the ball; and (c) maintenance of the very high energy density inside the ball for a considerable length of time. E.M.Dembinski

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21394
ATMOSPHERICS ON 20 kc/s AT THE TIME OF LOCAL AURORAE.

E.Gherzi.

Nature (London), Vol. 187, 225-6 (July 16, 1960).

On 30 occasions when bright aurorae were seen at Montreal, Canada, violent bursts of atmospherics were recorded simultaneously on a frequency of 20 kc/s. These latter are explained by the presence of ionized strips of the lower stratosphere, or upper troposphere. The patchy ionization is caused by the entry of auroral particles at these levels, and it is sufficiently intense to enhance the degree of reflection of distant atmospherics. D.R.Barber

551.5

21395
OBSERVATIONS OF "WHISTLERS" AND "CHORUS" AT THE SOUTH POLE.

L.H.Martin.

Nature (London), Vol. 187, 1018-19 (Sept. 17, 1960).

The seasonal variation of "chorus", with maximum activity occurring in mid-summer, suggests direct dependence on solar radiation probably being initiated by solar corpuscular radiation impinging on the outer ionosphere. The "whistlers" appear to be produced at lower latitudes, reaching the receiver by reflections between the earth and lower ionosphere, and the seasonal and diurnal variation may be due to the corresponding variations in D region absorption over the path of propagation. Low-frequency hiss associated with aurorae was also observed. The frequency of hiss may decrease with geomagnetic latitude. C.Hazard

551.5

21396
GEOMAGNETIC NOISE AT 230 Kc/s.

R.L.Dowden.

Nature (London), Vol. 187, 677-8 (Aug. 20, 1960).

Simultaneous observations at 4, 9, 70 and 230 kc/s have been made and noise bursts recorded during geomagnetically disturbed periods. A Cherenkov mechanism is proposed for the observed emission, and the relative signal strength on 9 and 230 kc/s is explained on a quantitative basis. H.J.A.Chivers

551.5 : 621.39.821

21397
ATMOSPHERIC NOISE INTERFERENCE IN THE STANDARD BROADCAST BAND AT POONA.

S.V.Chandrashekhar Aiya and C.G.Khot.

J. sci. industr. Res., Vol. 18B, No. 2, 54-66 (Feb., 1959).

A report of some of the investigations carried out at Poona on atmospheric radio noise in the standard broadcast band (0.535-1.605 Mc/s) are presented. Systematic measurements were taken at 0.62 and 0.93 Mc/s during the hours 1800-2300 I.S.T., from March 1955 to February 1956, by a method previously described by one of the authors [J. atmos. terres. Phys., Vol. 5, 230 (1954)]. A possible way of noise estimation is described and the actual estimates compared with measured values. In Appendix I are given the details of the equipment designed and used in the measurements and in Appendix II a comparison is made of the available estimates of atmospheric noise with the measured values.

551.5 : 621.391.821

21398
ATMOSPHERIC RADIO NOISE LEVELS AT POONA IN THE 2.5-20 Mc/s BAND.

S.V.Chandrashekhar Aiya, K.R.Phadke, S.C.Padmanabhan and C.K.Sane.

J. sci. Industr. Res., Vol. 18B, No. 2, 47-53 (Feb., 1959).

Noise data in a form which includes both the amplitude and time characteristics of atmospheric radio noise presented. The amplitude characteristics are given in terms of the r.m.s. noise field strength corresponding to the average power received per flash. The time characteristics are given in terms of the median, higher decile and lower decile values of the duration of the impulse which arises from a flash and of the minimum number of impulses per minute necessary to cause annoyance or impair intelligibility of any service. The actual numerical data pertain to Poona for the time block 1800-2400 hrs I.S.T. and for the frequency band 2.5-20 Mc/s

551.5 : 621.391.822

21399 MEASUREMENT AND DESCRIPTION OF THE CHARACTERISTICS OF ATMOSPHERIC RADIO NOISE.
S.V.Chandrashekhar Aiya.
J. sci. industr. Res., Vol. 18B, No. 2, 43-7 (Feb, 1959).

On the basis of the experimental and theoretical investigati
carried out by the author and his collaborators at Poona during
hours of peak activity of tropical thunderstorms, an attempt is
made to find an answer to the question of the C.C.I.R., namely,
are the most easily measured characteristics of terrestrial rad
noise from which the interference to different types of communi
tion systems can be determined?

BIOPHYSICS · PHYSIOLOGICAL PHYSICS

574 : 621.374.32 : 621.389

21400 TRANSISTOR SWITCH STIMULUS ISOLATOR.
H.Fein.
Rev. sci. Instrum., Vol. 31, No. 10, 1070-2 (Oct., 1960).

The instrument described provides rectangular pulses separated from ground by less than 20 pF capacity and essentially infinite resistance. The transistor switch provides pulses at low output impedance, from a floating battery, of 0 to 80 V in amplitude and variable in duration by the width of a triggering stimulus from a conventional stimulator or pulse generator. The device is of particular use in biological experiments where isolation of a stimulating pulse from ground is required.

61

21401 SIMPLE VERSATILE VOLUMETER.
O.f.Wiegand and A.R.Schrank.
Rev. sci. Instrum., Vol. 31, No. 11, 1234-7 (Nov., 1960).

The design and principles of operation of a direct reading Lucite volumeter for use in the study of respiration, photosynthesis, and gas exchange reactions is described. The detection and compensation device consists of two rigidly coupled pistons driven by a knurled nut; as one piston is moved to compensate for a volume change in the compensation chamber, the displacement is magnified by the larger piston and can be observed as fluid displacement in a graduated pipette. The chambers, pistons, and manometer assembly are exchangeable to permit selection of the relative sensitivity and amplification, in keeping with the temperature control and the absolute magnitude of the volume increments to be detected. With temperature control of ±0.05°C, a thermal stability of 0.2 μl/hr may be achieved and rates of 2.0 μl/hr resolved at 5 min intervals. Absolute measurements of 0.1 μl may be made. The respirometer is provided with gassing vents. A simple pump may be used for the agitation of the respiration chamber atmosphere to accelerate equilibrium and improve the response time of the instrument. Representative measurements are included.

61 : 621.374.32 : 621.389

21402 TRANSISTORIZED RATEMETER DESIGN.
J.F.Marvin, W.D.Miller and M.K.Loken.
Rev. sci. Instrum., Vol. 31, No. 11, 1238-40 (Nov., 1960).

Extensively increasing adaptation and use of radioactive isotopes for in vivo studies of the circulatory system has dictated improvement in the electronic instrumentation necessary to detect and measure progress of the isotope through the system. Inasmuch as the time intervals of circulatory studies are rather short (not over 30 sec), speaking on a gross scale, measurements at several different checkpoints must be accomplished with duplicate immobilized detectors rather than a single movable unit. A transistorized ratemeter featuring lower power requirements, smaller space consumption, superior reliability and durability together with the stability of vacuum tube circuits in a.c. operation has been developed to make practicable multiple channel in vivo counting systems for use in the modern X-ray or operating room.

61 : 621.317.39 : 621.389

21403 CAPACITANCE TRANSDUCERS FOR MUSCLE RESEARCH. M.O.Schilling.
Rev. sci. Instrum., Vol. 31, No. 11, 1215-17 (Nov., 1960).

Apparatus has been developed for the measurement of shortening and tension of isolated muscle using variable capacitance methods. An isotonic transducer is described which will measure up to 2.5 cm of shortening with a minimum of inertial loading with 1% linearity. An isometric transducer is described which will
measure tensions up to 100 g with not more than 5 μ displaceme
from 0 to 200 c/s. Simple modifications provide other ranges of
tension.

61 : 621.

21404 INTERFERENCE-FREE INTEGRATION OF A BLOO
GAS ANALYZER INTO A POLYGRAPHIC SYSTEM F
RECORDING PHYSIOLOGICAL ACTIVITIES.
J.B.Harlin and M.Cohen.
Rev. sci. Instrum., Vol. 31, No. 11, 1245-6 (Nov., 1960).

Hearing . Speech

6

21405 SPOKEN DIGIT RECOGNITION USING TIME-FREQUENCY PATTERN MATCHING.
P.Denes and M.V.Mathews.
J. Acoust. Soc. Amer., Vol. 32, No. 11, 1450-5 (Nov., 1960).

A study of the machine recognition of the spoken digits zero
through nine has been carried out by a digital computer simulati
The spoken utterances were converted to time-frequency pattern
of spectral energy. Recognition was done by cross correlating t
pattern of an unknown utterance with a test pattern for each digit
and selecting the digit having the highest correlation. Time nor
zation could be applied to all patterns, thus reducing utterances
a standard duration. Six male and one female speakers provided
38 samples of each of the 10 digits. Pauses were made between
successive words for segmentation. No errors were observed
recognizing a single speaker using test patterns from his own sp
with time normalization. A group of five male speakers and test
patterns averaged over the group produced 6% errors with time
normalization and 12% without. A 25% rate occurred for the wo
matched against male patterns. The study indicates both the
effectiveness and limitations of this simple recognition procedur
limited vocabularly and limited number of speakers. Time norm
zation improves performance in all cases.

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21406 PITCH DISCRIMINATION OF TWO-FREQUENCY COMPLEXES. G.R.Schodder and E.E.David, Jr.
J. Acoust. Soc. Amer., Vol. 32, No. 11, 1426-35 (Nov., 1960).

Apparently the pitch difference limen (DL) for a single high
frequency sinusoid can be smaller in the presence of a nearby
constant frequency component than in isolation. It is demonstra
that this effect arises from the time-envelope properties of the
frequency complex. This result is consonant with those of Flana
and Saslow (Abstr. 160 of 1959) who found that the pitch DL of a
periodic vowel sound is smaller than the DL of a sinusoid at the
fundamental frequency.

21407 DISCRIMINATION OF THE TIME INTERVAL BETW
TWO SHORT ACOUSTIC PULSES. L.A.Chistovich.
Akust. Zh., Vol. 5, No. 4, 480-4 (1959). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No. 4, 493-7 (April-June, 1960).

The discriminatory sensitivity to the time interval between
short acoustic pulses as a function of the initial magnitude of th
interval was investigated. The results for the time-interval dis
mination agreed closely with the data on discrimination of the no
interruption frequency. It was concluded that the same auditory
mechanism was involved in both types of discrimination.

LIST OF JOURNALS

The following list supplements the List of Journals published with the Index to Volume 62 (1959). Reprints of the List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free. The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Arch. Automat. Telemekh.	Archiwum Automatyki i Telemekhaniki Polska Akademia Nauk, Zakład Automatyki. Subscription address: PKWZ "Ruch", ul. Wilcza 46, Warsaw.
I.R.E. internat. Convention Record	I.R.E. International Convention Record (Formerly: I.R.E. National Convention Record). Institute of Radio Engineers, 1 East 79th Street, New York 21, N.Y.
Kumamoto J. Sci. A	Kumamoto Journal of Science. Series A (Mathematics, Physics and Chemistry). Faculty of Science, Kumamoto University, Kumamoto.
State Inst. Tech. Res. Rep. (Finland)	State Institute for Technical Research. Reports. Series II (Metal and Electricity). Lönnrotinkatu 37, Helsinki.

CHANGE OF TITLE

I.R.E. Nat. Convention Record	I.R.E. National Convention Record Title changed to: I.R.E. International Convention Record (I.R.E. internat. Convention Record) with Vol. 8, 1960.

ERRATA

Abstr. 42 (1956) line 3: for "March" read "May"
Abstr. 100 (1956) line 4: for "March" read "May
Author Index (June, 1960): for "Lynbimov,V.B." read "Lyubimov,V.B."
Author Index (Oct., 1960): delete Zimmermann,G., 14773
Oct. (1960) p. 1449: for Abstract number "134654" read "14654"
Abstr. 5595 (1960) line 3: for "A.M.Baldwin" read "A.M.Baldin"
Abstr. 16836 (1960) line 5: for "$W = MR\ TB^{\alpha}$" read "$W = MR/TB^{\alpha}$"
Abstr. 17488 (1960) line 3: for "M.Hammermesh" read "M.Hamermesh"
Abstr. 18054 (1960) line 3: for "G.B.Abdullayev" read "G.B.Abdullaev"

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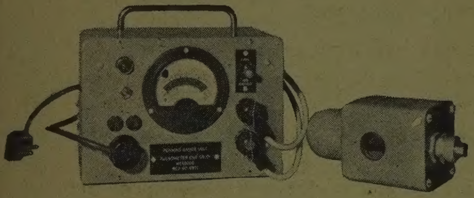

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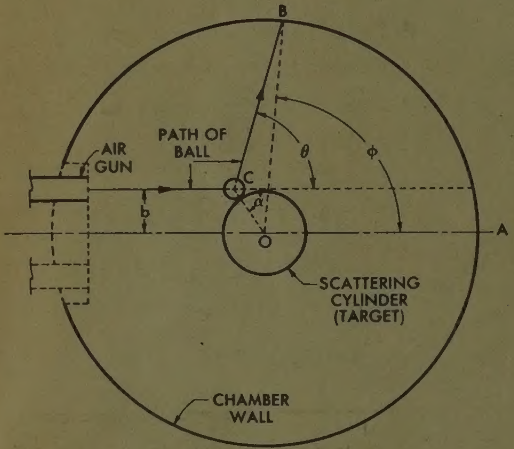

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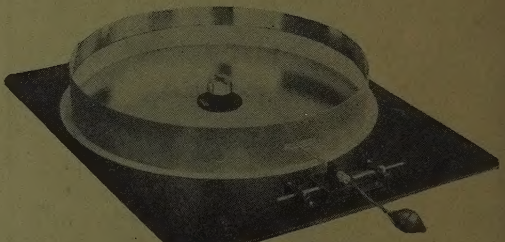
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